

**ACADEMIC REGULATIONS  
COURSE STRUCTURE  
AND  
DETAILED SYLLABI  
OF  
ELECTRONICS AND COMMUNICATION ENGINEERING  
FOR  
B.TECH REGULAR FOUR YEAR DEGREE PROGRAM  
*(For the batches admitted from 2019-2020)*  
&  
FOR B.TECH LATERAL ENTRY PROGRAM  
*(For the batches admitted from 2020-2021)*  
CHOICE BASED CREDIT SYSTEM**



**SREE VIDYANIKETHAN ENGINEERING COLLEGE (AUTONOMOUS)**

**(Affiliated to JNTUA, Ananthapuramu, Approved by AICTE, Programs Accredited by NBA,  
Accredited by NAAC with 'A' grade)  
SREE SAINATH NAGAR, A. Rangampet -517102:: NEAR TIRUPATI (A.P)**

## **VISION**

To be one of the Nation's premier Engineering Colleges by achieving the highest order of excellence in Teaching and Research.

## **MISSION**

- To foster intellectual curiosity, pursuit and dissemination of knowledge.
- To explore students' potential through academic freedom and integrity.
- To promote technical mastery and nurture skilled professionals to face competition in ever increasing complex world.

## **QUALITY POLICY**

Sree Vidyanikethan Engineering College strives to establish a system of Quality Assurance to continuously address, monitor and evaluate the quality of education offered to students, thus promoting effective teaching processes for the benefit of students and making the College a Centre of Excellence for Engineering and Technological studies.

## **DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING**

### **Vision**

To be a center of excellence in Electronics and Communication Engineering through teaching and research producing high quality engineering professionals with values and ethics to meet local and global demands.

### **Mission**

- The Department of Electronics and Communication Engineering is established with the cause of creating competent professionals to work in multicultural and multidisciplinary environments.
- Imparting knowledge through contemporary curriculum and striving for development of students with diverse background.
- Inspiring students and faculty members for innovative research through constant interaction with research organizations and industry to meet societal needs.
- Developing skills for enhancing employability of students through comprehensive training process.
- Imbibing ethics and values in students for effective engineering practice.

## **PROGRAM EDUCATIONAL OBJECTIVES**

After few years of graduation, the graduates of B.Tech. (ECE) will be:

1. Enrolled or completed higher education in the core or allied areas of electronics and communication engineering or management.
2. Successful entrepreneurial or technical career in the core or allied areas of electronics and communication engineering.
3. Continued to learn and to adapt to the world of constantly evolving technologies in the core or allied areas of electronics and communication engineering.

## **PROGRAM OUTCOMES**

On successful completion of the Program, the graduates of B.Tech. (ECE) Program will be able to:

1. Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write

effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

### **PROGRAM SPECIFIC OUTCOMES**

On successful completion of the Program, the graduates of B. Tech. (ECE) program will be able to:

- PS01:** Design and develop customized electronic circuits for domestic and industrial applications.
- PS02:** Use specific tools and techniques to design, analyze and synthesize wired and wireless communication systems for desired specifications and applications.
- PS03:** Apply suitable methods and algorithms to process and extract information from signals and images in Radar, Satellite, Fiber optic and Mobile communication systems.

**SREE VIDYANIKETHAN ENGINEERING COLLEGE(AUTONOMOUS)**  
**(Affiliated to J.N.T.University Anantapur, Ananthapuramu)**

**ACADEMIC REGULATIONS (SVEC-19)**

**CHOICE BASED CREDIT SYSTEM**

**B.Tech. Regular Four Year Degree Program**

**(For the batches admitted from the academic year 2019–20)**

**and**

**B.Tech. (Lateral Entry Scheme)**

**(For the batches admitted from the academic year 2020-21)**

For pursuing four year undergraduate Degree Program B.Tech offered by SreeVidyanikethanEngineeringCollege under Autonomous status and herein after referred to as SVEC:

**1. Applicability:**

All the rules specified herein, approved by the Academic Council, shall be in force and applicable to students admitted from the academic year 2019-2020 onwards. Any reference to "College" in these rules and regulations stands for SVEC.

**2. Extent:**

All the rules and regulations, specified hereinafter shall be read as a whole for the purpose of interpretation and as and when a doubt arises, the interpretation of the Chairman, Academic Council is final. It shall be ratified by the Academic Council in the forthcoming meeting. As per the requirements of statutory bodies, Principal, Sree Vidyanikethan Engineering College shall be the Chairman, Academic Council.

**3. Admission:**

**3.1. Admission into First Year of Four Year B.Tech. Degree Program in Engineering:**

**3.1.1. Eligibility:** A candidate seeking admission into the First Year of four year B.Tech. Degree Program should have:

Passed either Intermediate Public Examination (I.P.E.) conducted by the Board of Intermediate Education, Andhra Pradesh, with Mathematics, Physics and Chemistry as optional courses (or any equivalent examination recognized by JNTUA, Ananthapuramu) for admission as per the guidelines of Andhra Pradesh State Council of Higher Education (APSCHE).

**3.1.2. Admission Procedure:** Admissions shall be made into the first year of four year B.Tech. Degree Program as per the stipulations of APSCHE, Government of Andhra Pradesh:

- (a) By the Convener, EAMCET, (for Category-A Seats).
- (b) By the Management (for Category-B Seats).
- (c) By the Management (for 15% Supernumerary Quota) for Persons of Indian Origin (PIO)/Foreign Nationals (FN)/ Children of Indian Workers in Gulf Countries/ Overseas Citizen of India (OCI)

### **3.2. Admission into the Second Year of Four year B.Tech Degree Program in Engineering (Lateral Entry).**

**3.2.1. Eligibility:** A candidate seeking admission into the Second Year of four year B.Tech. Degree Program (Lateral Entry) should have:

- (i) Passed Diploma in Engineering in the relevant branch conducted by the Board of Technical Education, Andhra Pradesh (or equivalent Diploma recognized by JNTUA, Ananthapuramu).
- (ii) Candidates qualified in ECET and admitted by the Convener, ECET. In all such cases for admission, when needed, permissions from the statutory bodies are to be obtained.

**3.2.2. Admission Procedure:** 10% of the sanctioned strength in each Program of study as lateral entry students or as stipulated by APSCHE shall be filled in by the Convener, ECET.

### **4. Programs of study offered leading to the award of B.Tech. Degree:**

Following are the four year undergraduate Degree Programs of study offered in various branches in SVEC leading to the award of B.Tech (Bachelor of Technology) Degree:

- 1) Civil Engineering
- 2) Electrical and Electronics Engineering
- 3) Mechanical Engineering
- 4) Electronics and Communication Engineering
- 5) Computer Science and Engineering
- 6) Electronics and Instrumentation Engineering
- 7) Information Technology
- 8) Computer Science and Systems Engineering

### **5. Duration of the Program:**

**5.1 Minimum Duration:** The program shall extend over a period of four years leading to the Degree of Bachelor of Technology (B.Tech) of the JNTUA, Ananthapuramu. The four academic years shall be divided into eight semesters with two semesters per year. Each semester shall normally consist of 21 weeks

(Minimum of 90 working days) having - Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), Choice Based Credit System (CBCS) and Credit Based Semester System (CBSS) as suggested by UGC and Curriculum/ Course Structure as suggested by AICTE are followed. Provision is made for lateral entry admission of students into the Second Year of the program in all the branches of study and they shall be required to satisfy the conditions of admissions thereto prescribed by the JNTUA, Ananthapuramu and Government of Andhra Pradesh.

## 5.2 Maximum Duration:

The student shall complete all the passing requirements of the B.Tech degree program within a maximum duration of 8 years (6 years for lateral entry), these durations reckoned from the commencement of the semester to which the student was first admitted to the program.

## 6. Structure of the Program:

Each Program of study shall consist of:

- (i) HS (Humanities and Social Sciences) Courses
- (ii) BS (Basic Sciences) Courses
- (iii) ES (Engineering Sciences) Courses
- (iv) PC (Professional Core) Courses
- (v) PE (Professional Electives)
- (vi) OE (Open Electives) Courses
- (vii) Mandatory Courses (MC)
- (viii) Audit Courses (AC)
- (ix) Projects (PR) (Socially Relevant Projects, Internship, Project Work)

S.No	Course Category	Course Type	No. of Credits
1.	HS – Humanities and Social Sciences	Humanities, Social Sciences and Management.	11
2.	BS – Basic Sciences	Mathematics, Physics and Chemistry Courses, etc.	22
3.	ES – Engineering Sciences	Fundamental Engineering courses.	22-23
4.	PC – Professional Core	Core courses related to the Parent Discipline/ Branch of Engg.	60-61
5.	PE – Professional Electives	Elective courses related to the Parent Discipline/ Branch of Engg.	15
6.	OE – Open Electives	Electives from other technical and /or emerging subjects	15
7.	PR - Projects	Socially Relevant Projects, Internship, Project Work	14
8.	MC - Mandatory Courses	Induction Program, Environmental Science, Universal Human Values	--
9.	AC - Audit Courses	Skill Development / Value Added Courses.	--



## **Contact Periods:**

The contact periods per week are assigned depending on the complexity and volume of the course.

## **7. Credit Courses:**

All Courses are to be registered by a student in a Semester to earn Credits. Credits shall be assigned to each Course in a L: T: P: C (Lecture Hours: Tutorial Hours: Practical Hours: Credits) Structure, based on the following general pattern.

- **Theory Courses:** One Lecture Hour (L) per week in a semester: 01 Credit
- **Practical Courses:** One Practical Hour (P) Per week in a semester: 0.5 Credit
- **Tutorial:** One Tutorial Hour (T) Per week in a semester: 01 Credit
- **Mandatory Courses:** No **CREDIT** is awarded.
- **Audit Courses:** No **CREDIT** is awarded.
- **Open Elective** (MOOC): 03 Credits

Student activities like NCC, NSS, Sports, Study Tour and Guest Lecture etc. shall not carry ANY Credits.

For Socially Relevant Projects, Internship and Project Work where formal contact periods are not specified, credits are assigned based on the complexity of the work to be carried out.

The four year curriculum of any B. Tech Program of study shall have a total of **160** credits. However the curriculum for students admitted under lateral entry shall have a total of **118** credits.

## **8. Choice Based Credit System (CBCS):**

Choice Based Credit System (CBCS) is introduced in line with UGC guidelines in order to promote:

- Student centred learning
- Students to learn courses of their choice
- Interdisciplinary learning

A Student has a choice of registering for courses comprising program core, professional electives, open electives, MOOC courses, value added / Skill based courses. Besides, choice is also offered to students for registering courses to earn Minor in Engineering/Honors degree.

## **9. Course Enrollment and Registration**

- 9.1** Each student, on admission shall be assigned to a Faculty Advisor (Mentor) who shall advice and counsel the student about the details of the academic program

and the choice of courses considering the student's academic background and career objectives.

- 9.2** Each student on admission shall register for all the courses prescribed in the curriculum in the student's first and second Semesters of study. The student shall enroll for the courses with the help of the student's Faculty Advisor (Mentor). The enrollment for the courses from II B.Tech I Semester to IV B.Tech I Semester shall commence 10 days prior to the last instructional day of the preceding semester for registration process. If the student wishes, the student may drop or add courses (vide clause 8) 10 days prior to commencement of the concerned semester and complete the registration process duly authorized by the Chairman, Board of Studies of concerned department.
- 9.3** If any student fails to register the courses in a semester, he shall undergo the courses as per the program structure.
- 9.4** After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the Semester-end Examinations.
- 9.5** Elective courses shall be offered by a Department only if a minimum of 40 students register for that course.

## **10. OPEN ELECTIVE (MOOC)**

OPEN ELECTIVE (MOOC) is an online course aimed at unlimited participation and open access via the web.

- 10.1** A Student is offered an Open Elective (MOOC), in the IV B.Tech I-Semester, and is pursued through Massive Open Online Course (MOOC) platforms. The duration of the MOOC courses shall be for a minimum period of 08 weeks.
- 10.2** The student shall confirm registration by enrolling the course within 10 days prior to the last instructional day of the III B.Tech II-Semester along with other courses.
- 10.3** The list of courses along with MOOC service providers shall be identified by the Chairman, BOS, and Head of the Department. The identified Open Elective (MOOC) courses are to be approved by the Chairman, Academic Council.
- 10.4** The student has to submit MOOC certificate with percentage of Score earned to the Head of the Department at the end of the semester. Based on the score earned, the equivalent Grade Point and Credits will be assigned.

**10.5** Attendance is not applicable for MOOC Course and also attendance will not be monitored.

**10.6** If the student fails to submit the MOOC certificate at the end of the semester, his performance in MOOC will be shown as "Fail" in the Grade sheet. Then the student shall register for the supplementary examinations and submit the MOOC certificate.

## **11. BREAK OF STUDY FROM A PROGRAM (Gap Year)**

**11.1** A student is permitted to go on break of study for a maximum period of two years either as two breaks of one year each or a single break of two years.

**11.2** In case, a student wishes to extend the gap year for one more consecutive year, he shall be permitted with the prior approval of the Principal on the recommendations of the Head of the Department prior to the beginning of the semester in which he has taken break of study.

**11.3** The student shall apply for break of study in advance, in any case, not later than the last date of the first assessment period in a semester. The gap year concept is introduced for start-up (or) incubation of an idea, National/International Internships, and professional Volunteering. The application downloaded from the website and duly filled in by the student shall be submitted to the Principal through the Head of the department. A committee shall be appointed by the Principal in this regard. Based on the recommendations of the committee, Principal shall decide whether to permit the student to avail the gap year or not.

**11.4** The students permitted to rejoin the program after break of study shall be governed by the Curriculum and Regulations in force at the time of rejoining.

The students rejoining in new regulations shall apply to the Principal in the prescribed format through Head of the Department, at the beginning of the readmitted semester for registering additional/equivalent courses to comply with the curriculum in-force.

**11.5** The two years period of break of study shall not be counted for the maximum Period of graduation (i.e the maximum period of graduation is 10 years for Regular admitted students and 8 years for Lateral Entry admitted students availing Gap Year).

**11.6** If a student has not reported to the college after completion of the approved period of break of study he is deemed to be detained in that semester. Such students are eligible for readmission into the semester when offered next.

## **12. Examination System:**

**12.1** All components in any Program of study shall be evaluated through internal evaluation and/or an external evaluation conducted as Semester-end examination.

<b>Sl. No.</b>	<b>Course</b>	<b>Marks</b>	<b>Examination and Evaluation</b>		<b>Scheme of examination</b>
1.	Theory	60	Semester-end examination for 3 hours duration (External evaluation)		The examination question paper in theory courses shall be for a maximum of 60 marks. The question paper shall be of descriptive type with 10 questions each of 12 marks, taken two from each unit. Each unit shall have internal choice and 5 questions shall be answered, one from each unit.
		40	10	Assignments (Internal evaluation).	One Assignment shall be given to the student for 10 marks during the semester and Assignment Marks finalized.
			30	Mid-term Examination of 2 hours duration (Internal evaluation).	Two mid-term examinations each for 30 marks are to be conducted. For a total of 30 marks, 80% of better one of the two and 20% of the other one are added and finalized. <b>Mid-I:</b> After first spell of instruction (I & II Units). <b>Mid-II:</b> After second spell of instruction (III, IV & V Units). The question paper shall be of descriptive type with 5 essay type questions each of 8 marks, out of which 3 are to be answered and evaluated for 24 marks. There shall also be 6 short answer questions each of 01 mark, all are to be answered and evaluated for 6 marks.
2.	Laboratory	50	Semester-end Lab Examination for 3 hours duration (External evaluation)		The examination shall be conducted by the faculty member handling the laboratory (Examiner-2) and another faculty member (Examiner-1) appointed by the Chief Controller of Examinations.
		50	30	Day-to-Day evaluation for Performance in laboratory experiments and Record. (Internal evaluation).	Two laboratory examinations, which includes Day-to-Day evaluation and Practical test, each for 50 marks are to be evaluated by the faculty members handling the laboratory. For a total of 50 marks 80% of better one of the two and 20% of the other one are added and finalized. <b>Laboratory examination-I:</b> Shall be

Sl. No.	Course	Marks	Examination and Evaluation		Scheme of examination
			20	Practical test (Internal evaluation).	conducted just before FIRST mid-term examinations. <b>Laboratory examination-II:</b> Shall be conducted just before SECOND mid-term examinations.
3.	Internship	100	Semester-end Examination		The evaluation shall be done by the Department Evaluation Committee ( <b>DEC</b> ) at the end of the semester as given in 12.2.1.
4.	Open Elective (MOOC)	100	-		The student has to submit MOOC certificate with percentage of Score earned to the Head of the Department at the end of the semester. Based on the score the equivalent Grade Point and Credits will be assigned as given in 10.4.
5.	Socially Relevant Project	100	50	Internal Evaluation	Shall be evaluated as given in 12.2.2(i)
			50	Semester-end evaluation	Viva-Voce examination shall be conducted at the end of the semester as given in 12.2.2(ii)
6.	Mandatory Courses	40	Internal Evaluation		Shall be evaluated as given in 12.2.4
7.	Audit Courses	-	-		As detailed in 12.2.5
8.	Project Work	200	100	Internal evaluation	Continuous evaluation shall be done by the Project Evaluation Committee ( <b>PEC</b> ) as given in 12.2.3.
			100	Semester-end evaluation	Project Work Viva-Voce Examination shall be conducted by a Committee at the end of the semester as given in 12.2.3.

## 12.2 Internship/Socially Relevant Project/Project Work/Mandatory Course/ Audit Course Evaluation:

### 12.2.1 Internship:

The student shall undergo **Internship** in an Industry/National Laboratories/Academic Institutions relevant to the respective branch of study. This course is to be registered during III B.Tech II-Semester and taken up during the summer vacation after completion of the III B.Tech II-Semester, for a period of FOUR weeks duration. The Industry Training/Internship shall be submitted in a Report form, and a presentation of the same shall be made before a Department Evaluation Committee (DEC) and it should be evaluated for 100 marks. The DEC shall consist of the Head of the Department, the concerned Supervisor and a Senior Faculty Member of the Department. The DEC is constituted by the Chief Controller of Examinations on the recommendations of the Head of the Department. There shall be no internal marks for Internship. The Internship shall be evaluated at the end of the IV B.Tech I-Semester.

### **12.2.2 Socially Relevant Project:**

A project for community services shall be carried out in teams (maximum 5 students per team) to solve real life problems of society. The Students shall visit the society (Villages/Hospitals/social service organizations etc,.) to identify the problem, conduct literature survey and provide a feasible solution. Each team shall work under the supervision of a guide (faculty member).

- (i) Internal Evaluation: Two internal evaluations (First evaluation before the I-Mid-term examinations and second evaluation before the II-Mid-term examinations) shall be conducted by the guide and a faculty member nominated by the HOD. For a total of 50 marks, 80% of better one of the two and 20% of the other one are added and finalized.
- (ii) Semester-end Evaluation: A report on socially relevant project shall be submitted by the team of students to the department at the end of the semester. The Viva-Voce examination shall be conducted by the concerned guide and a senior faculty member recommended by the Head of the Department and appointed by the Chief Controller of Examinations.

### **12.2.3 Project Work:**

- (i) Internal Evaluation: The Internal Evaluation shall be made by the Project Evaluation Committee (PEC) consisting of concerned supervisor and two senior faculty members, on the basis of TWO project reviews on the topic of the project. Each review shall be conducted for a maximum of "100" marks. For a total of 100 marks, 80% of better one of the two and 20% of the other one are added and finalized. The PEC is constituted by the Principal on the recommendations of the Head of the Department.
- (ii) Semester-end Evaluation: The Semester-end Project Work Viva-Voce Examination shall be conducted by a Committee consisting of External examiner (nominated by the Chief Controller of Examinations), HOD and concerned Supervisor. The evaluation of project work shall be done at the end of the IV B.Tech II Semester.

Three copies of the dissertation certified in the prescribed format by the concerned Supervisor and HOD shall be submitted to the Department. One copy is to be submitted to the Chief Controller of Examinations. The examiner shall be nominated by the Chief Controller of the Examinations from the panel of SIX examiners submitted by the Department.

#### **12.2.4 Mandatory Courses:**

Mandatory courses carry **"ZERO"** credits. There shall be **NO Semester-end** examination. However, ATTENDANCE in Mandatory courses shall be considered while calculating aggregate attendance in a semester. The internal examination shall be conducted and evaluated similar to the THEORY courses. The student shall be declared to have passed the mandatory courses only when HE secures **40% marks in the internal examination**. If the student FAILS, a re-examination shall be conducted for FAILED candidates in the CONSEQUETIVE semester. The performance of the student shall be indicated in the grade sheets **"SATISFACTORY" (or) "NOT SATISFACTORY"** as given in 17.1. The student should pass all the mandatory courses, for the award of B.Tech degree.

#### **12.2.5 Audit Courses:**

Audit courses carry "ZERO" credits. There shall be **NO Internal and Semester-end examination**. However, ATTENDANCE in Audit courses shall be considered while calculating aggregate attendance in a semester. The student should study all the audit courses, and it shall be indicated in the GRADE Sheet.

#### **12.3. Eligibility to appear for the Semester-End Examination (SEE):**

- 12.3.1** A student shall be eligible to appear for semester-end examinations if he acquires a minimum of 75% of attendance in aggregate of all the courses in a semester.
- 12.3.2** Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.
- 12.3.3** Shortage of Attendance below 65% in aggregate **shall in no case be condoned**.
- 12.3.4** Students whose shortage of attendance is not condoned in any semester are not eligible to take their semester-end examinations of that class and their registration shall stand cancelled.
- 12.3.5** A student shall not be promoted to the next semester unless he satisfies the attendance requirements of the current semester, as applicable. The student may seek readmission for the semester when offered next. He shall not be allowed to register for the courses of the semester while he is in detention. A

student detained due to shortage of attendance, shall have to repeat that semester when offered next.

**12.3.6** A stipulated fee shall be payable to the College towards Condonation of shortage of attendance.

**12.3.7** The attendance in **Student Development Activities** shall be considered for finalization of aggregate attendance.

**12.3.8** For the calculation of a student attendance in any semester, the total number of classes conducted shall be counted as scheduled in the class-work time table.

#### **12.4. Evaluation:**

Following procedure governs the evaluation.

**12.4.1.** Marks for components evaluated internally by the faculty shall be submitted to the Controller of Examinations one week before the commencement of the Semester-end examinations. The marks for the internal evaluation components shall be added to the external evaluation marks secured in the Semester-end examinations, to arrive at the total marks for any course in that semester.

**12.4.2.** Performance in all the courses is tabulated course-wise and shall be scrutinized by the Results Committee and moderation is applied if needed and course-wise marks are finalized. Total marks obtained in each course are converted into letter grades.

**12.4.3.** Student-wise tabulation shall be done and individual grade Sheet shall be generated and issued to the student.

#### **12.5. Recounting/Revaluation/Personal Verification/Challenging Evaluation:**

Students shall be permitted to apply for **Recounting/Revaluation/Personal Verification/Challenging Evaluation** of the Semester-end examination answer scripts within a stipulated period after payment of the prescribed fee. After completion of the process of **Recounting/Revaluation/Personal Verification/Challenging Evaluation**, the records are updated with changes if any, and the student shall be issued a revised grade sheet. If there are no changes, the student shall be intimated the same through a notice.

#### **12.6. Supplementary Examination:**

In addition to the regular semester-end examinations conducted, the College may also schedule and conduct supplementary examinations for all the courses



of other semesters when feasible for the benefit of students. Such of the candidates writing supplementary examinations may have to write more than one examination per day.

**13. Academic Requirements for promotion/completion of regular B.Tech Program of study:**

The following academic requirements have to be satisfied in addition to the attendance requirements for promotion/completion of regular B.Tech Program of study.

**For students admitted into B.Tech. (Regular) Program:**

- 13.1** A student shall be deemed to have satisfied the minimum academic requirements for each theory course, laboratory course, socially relevant project and project work, if he secures not less than 40% of marks in the Semester-end examination and a minimum of 40% of marks in the sum total of the internal evaluation and Semester-end examination taken together. For the courses "**Internship**" and "**Open Elective (MOOC)**", he should secure not less than 40% of marks in the semester-end examination.
- 13.2** A student shall be promoted from second year to third year of Program of study only if he fulfills the academic requirement of securing 25 credits from the following examinations (Irrespective of whether or not the candidate appears for the semester-end examinations as per the normal course of study):
- a. **One** regular and **two** supplementary examinations of I B.Tech I Semester.
  - b. **One** regular and **one** supplementary examinations of I B.Tech II Semester.
  - c. **One** regular examination of II B.Tech I Semester.
- 13.3** A student shall be promoted from third year to fourth year of Program of study only if he fulfills the academic requirements of securing 42 credits from the following examinations (Irrespective of whether or not the candidate appears for the semester-end examinations as per the normal course of study):
- a. **One** regular and **four** supplementary examinations of I B.Tech I Semester.
  - b. **One** regular and **three** supplementary examinations of I B.Tech II Semester.
  - c. **One** regular and **two** supplementary examinations of II B.Tech I Semester.
  - d. **One** regular and **one** supplementary examinations of II B.Tech II Semester.
  - e. **One** regular examination of III B.Tech I Semester.

\* In case of getting detained for want of credits by sections 13.2 and 13.3 above, the student may make up the credits through supplementary examinations.

- 13.4** A student shall register for all the 160 credits and earn all the 160 credits. Marks obtained in all the 160 credits shall be considered for the calculation of the DIVISION based on CGPA.
- 13.5** A student who fails to earn 160 credits as indicated in the course structure within eight academic years from the year of their admission shall forfeit his seat in B.Tech. Program and his admission stands cancelled.

**For Lateral Entry Students (batches admitted from the academic year 2020-2021):**

- 13.6** A student shall be deemed to have satisfied the minimum academic requirements for each theory, practical course, Socially relevant project and Project Work, if he secures not less than 40% of marks in the semester-end examination and a minimum of 40% of marks in the sum total of the internal evaluation and semester-end examination taken together. For the courses "Internship" and "Open Elective (MOOC)", he shall be declared to have passed if he secures minimum of 40% of marks in the semester-end examination.
- 13.7** A student shall be promoted from third year to fourth year only if he fulfills the academic requirements of securing 25 credits from the following examinations:
- a. **One** regular and **Two** supplementary examinations of II B.Tech I Semester.
  - b. **One** regular and **One** supplementary examinations of II B.Tech II Semester.
  - c. **One** regular examination of III B.Tech I Semester.

Irrespective of whether or not the candidate appears for the semester-end examination as per the normal course of study and in case of getting detained for want of credits the student may make up the credits through supplementary examinations.

- 13.8** A student shall register for all 118 credits and earn all the 118 credits. Marks obtained in all the 118 credits shall be considered for the calculation of the DIVISION based on CGPA.
- 13.9** A student who fails to earn 118 credits as indicated in the course structure within six academic years from the year of their admission shall forfeit his seat in B.Tech Program and his admission stands cancelled.

#### **14. Minor degree in a discipline:**

The concept of Minor degree is introduced in the curriculum of all B. Tech. programs offering a Major degree. The main objective of Minor degree in a discipline is to provide additional learning opportunities for academically motivated students and it is an optional feature of the B.Tech. Program. In order to earn a Minor degree in a discipline, a student has to earn 18 extra credits (By studying FIVE theory & THREE laboratory courses or SIX Theory Courses) from the core courses of the minor discipline.

- a. Students having a CGPA of 8.0 or above up to II B.Tech I-Semester without any backlogs shall be permitted to register for Minor degree by paying the requisite fee.
- b. An SGPA and CGPA of 7.5 has to be maintained in the subsequent semesters without any backlog subjects in order to keep the Minor Degree registration live or else it shall be cancelled.
- c. Students aspiring for a Minor degree must register from III B.Tech I-Semester onwards and must opt for a Minor in a discipline other than the discipline he is registered in.
- d. A Student shall register for a Minor with following combinations:

**Offering Theory and Laboratory Courses:** SEVEN credits in a semester starting from III B.Tech I-Semester to III B.Tech II-Semester (TWO theory & ONE laboratory courses) and FOUR credits in IV B.Tech I-Semester (ONE theory & ONE laboratory courses).

**Offering Theory Courses only:** SIX credits in a semester starting from III B.Tech I-Semester to IV B.Tech I-Semester (TWO theory courses).

- e. The evaluation pattern of the courses shall be similar to the regular program courses evaluation.
- f. Minimum strength required for offering a Minor Degree in a discipline is 40 students.
- g. A student registered for Minor degree shall pass in all subjects that constitute the requirement for the Minor degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Minor degree program.
- h. The Minor degree shall be mentioned in the degree certificate as Bachelor of Technology in XXX with Minor in YYY. For example, Bachelor of Technology in Computer Science & Engineering with Minor in Title of the Minor Pursued. This shall also be reflected in the transcripts, along with the list of courses taken for

Minor degree program with CGPA mentioned separately.

- i. Separate course/class work and time table shall be arranged for the various Minor degree programs. Attendance regulations for these Minor discipline programs shall be as per regular courses.

**NOTE:** Interested meritorious students shall be permitted to register either for Minor degree in a discipline (or) Honors Degree in a discipline only, but not both.

#### **15. Honors degree in a discipline:**

The concept of Honors degree is introduced in the curriculum for all B. Tech. programs. The main objective of Honors degree is to provide additional learning opportunities for academically motivated students in the same or allied discipline and it is an optional feature of the B. Tech. program. In order to earn Honors degree in a discipline, a student has to earn **18** extra credits (By studying FIVE theory & THREE laboratory courses or SIX Theory Courses).

- a. Students having a CGPA of 8.0 and above up to II B.Tech I-Semester without any backlogs shall be permitted to register for Degree with Honors by paying the requisite fee.
- b. An SGPA and CGPA of 7.5 has to be maintained in the subsequent semesters without any backlog subjects in order to keep the Honors Degree registration live or else it shall be cancelled.
- c. Students aspiring for a Honors degree must register from III B.Tech I-Semester onwards.
- d. A Student shall register for a Honors with following combinations:

**Offering Theory and Laboratory Courses:** SEVEN credits in a semester starting from III B.Tech I-Semester to III B.Tech II-Semester (TWO theory & ONE laboratory courses) and FOUR credits in IV B.Tech I-Semester (ONE theory & ONE laboratory courses).

**Offering Theory Courses only:** SIX credits in a semester starting from III B.Tech I-Semester to IV B.Tech I-Semester (TWO theory courses).

- e. The evaluation pattern of the courses shall be similar to the regular program courses evaluation.
- f. Minimum strength required for offering a Honors in a discipline is 10% of sanctioned intake.

- g. A student registered for Honors degree shall pass in all subjects that constitute the requirement for the Honors degree program. No class/division (i.e., second class, first class and distinction, etc.) shall be awarded for Honors degree program.
- h. The Honors degree shall be mentioned in the degree certificate as Bachelor of Technology Honors in XXX. Example, Bachelor of Technology (Honors) in Computer Science & Engineering. This shall also be reflected in the transcripts, along with the list of courses taken for Honors degree program with CGPA mentioned separately.
- i. Separate course/class work and time table shall be arranged for the various Honors degree programs. Attendance regulations for these Honors discipline programs shall be as per regular courses.

**NOTE:** Interested meritorious students shall be permitted to register either for Minordegree in a discipline (or) Honors Degree in a discipline only, but not both.

#### **16. Transitory Regulations:**

Students who got detained for want of attendance (or) who have not fulfilled academic requirements (or) who have failed after having undergone the Program in earlier regulations (or) who have discontinued and wish to continue the Program are eligible for admission into the unfinished semester from the date of commencement of class work with the same (or) equivalent courses as and when courses are offered and they shall be in the academic regulations into which they are presently readmitted.

A regular student has to satisfy all the eligibility requirements within the maximum stipulated period of eight years and a lateral entry student within six years for the award of B.Tech Degree.

#### **17. Grades, Semester Grade Point Average and Cumulative Grade Point Average:**

- 17.1. Grade System:** After all the components and sub-components of any course (including laboratory courses) are evaluated, the final total marks obtained shall be converted into letter grades on a "10 point scale" as described below.

### Grades Conversion and Grade points Attached

% of Marks obtained	Grade	Description of Grade	Grade Points (GP)
> = 95	O	Outstanding	10
> = 85 to < 95	S	Superior	9
> = 75 to < 85	A	Excellent	8
> = 65 to < 75	B	Very Good	7
> = 55 to < 65	C	Good	6
> = 45 to < 55	D	Fair	5
> = 40 to < 45	E	Pass	4
< 40	F	Fail	0
Not Appeared	N	Absent	0
<b>For Mandatory Courses</b>			
>=40	P	Satisfactory	-
<40	I	Not Satisfactory	-

#### Pass Marks:

A student shall be declared to have passed theory course, laboratory course, Socially relevant project and project work if he secures minimum of 40% marks in external examination, and a minimum of 40% marks in the sum total of internal evaluation and external examination taken together. For Industrial training/internship he shall be declared to have passed if he secures minimum of 40% of marks in the semester-end examination. Otherwise, he shall be awarded fail grade - 'F' in such a course irrespective of internal marks. 'F' is considered as a fail grade indicating that the student has to pass the Semester-End Examination in that course in future and obtain a grade other than 'F' and 'N' for passing the course.

*For the Mandatory Courses, if the student obtained 40% or more marks, then his performance shall be indicated as "P" (SATISFACTORY), otherwise the performance shall be indicated as "I" (NOT SATISFACTORY) in the grade sheet.*

**17.2. Semester Grade Point Average (SGPA):** SGPA shall be calculated as given below on a "10 point scale" as an index of the student's performance:

$$SGPA = \frac{\sum (C \times GP)}{\sum C}$$

Where "C" denotes the "credits" assigned to the courses undertaken in that semester and "GP" denotes the "grade points" earned by the student in the respective courses.

**Note:** SGPA is calculated only for the candidates who appeared in the semester-end regular examinations in a particular semester:

### 17.3. Cumulative Grade Point Average (CGPA):

The CGPA shall be calculated for a candidate appeared in the Semester-end examinations for all the courses (including Regular & Supplementary) till that semester. The CGPA shall be displayed in the Grade sheet of the Regular Semester-end examinations and also in the consolidated Grade Sheet issued at the end of the program. The CGPA is computed on a 10 point scale as given below:

$$CGPA = \frac{\sum (C \times GP)}{\sum C}$$

where C denotes the credits assigned to courses undertaken up to the end of the Program and GP denotes the grade points earned by the student in the respective courses.

- 18. Grade Sheet:** A grade sheet (Marks Memorandum) shall be issued to each student on his performance in all the courses registered in that semester indicating the **SGPA and CGPA**.
- 19. Consolidated Grade Sheet:** After successful completion of the entire Program of study, a Consolidated Grade Sheet indicating performance of all academic years shall be issued as a final record. Duplicate Consolidated Grade Sheet shall also be issued, if required, after payment of requisite fee.
- 20. Award of Degree:** The Degree shall be conferred and awarded by Jawaharlal Nehru Technological University Anantapur, Ananthapuramu on the recommendations of the Chairman, Academic Council, SVEC (Autonomous).
- 20.1. Eligibility:** A student shall be eligible for the award of B.Tech Degree if he fulfills all the following conditions:
- Registered and successfully completed all the components prescribed in the Program of study to which he is admitted.
  - Successfully acquired the minimum required credits as specified in the curriculum corresponding to the branch of study within the stipulated time.

- Obtained CGPA greater than or equal to 4.0 (Minimum requirement for declaring as passed).
- Has NO DUES to the College, Hostel, Library etc. and to any other amenities provided by the College.
- No disciplinary action is pending against him.

**20.2. Award of Division:** Declaration of Division is based on CGPA.

#### **Awarding of Division**

<b>CGPA</b>	<b>Division</b>
$\geq 7.0$	First Class with Distinction
$\geq 6.0$ and $< 7.0$	First Class
$\geq 5.0$ and $< 6.0$	Second Class
$\geq 4.0$ and $< 5.0$	Pass Class

#### **21. Additional Academic Regulations:**

- 21.1** A student may appear for any number of supplementary examinations within the stipulated time to fulfill regulatory requirements for award of the degree.
- 21.2** In case of malpractice/improper conduct during the examinations, guidelines shall be followed as given in the ANNEXURE-I.
- 21.3** When a student is absent for any examination (Mid-term or Semester-end) he shall be awarded zero marks in that component (course) and grading shall be done accordingly.
- 21.4** When a component is cancelled as a penalty, he shall be awarded zero marks in that component.

#### **22. Withholding of Results:**

If the candidate has not paid dues to the College/University (or) if any case of indiscipline is pending against him, the result of the candidate shall be withheld and he shall not be allowed/promoted to the next higher semester.

#### **23. Re-Registration for Improvement of Internal Marks:**

Following are the conditions to avail the benefit of improvement of internal marks.

- 23.1** The candidate should have completed the 4 years of B.Tech course work and obtained examinations results from I B.Tech I Semester to IV B.Tech II semester.
- 23.2** Out of the courses the candidate has failed in the examinations due to internal evaluation marks secured being less than 40%, the candidate shall be given a chance for improvement of internal evaluation marks in the failed theory courses.



- 23.3 This provision is only for Theory courses. The candidate has to register for the chosen courses and fulfil the academic requirements (i.e. a student has to attend the classes regularly and appear for the mid-examinations and satisfy the attendance requirements to become eligible for appearing at the semester-end examinations).
- 23.4 For each course, the candidate has to pay a fee of Rs. 10,000/- and the amount is to be remitted in the form of D.D. in favor of the Principal, Sree Vidyaniketan Engineering College payable at Tirupati along with the requisition through the concerned Head of the Department.
- 23.5 In the event of availing the provision of Improvement of Internal evaluation marks, the internal evaluation marks as well as the Semester-end Examinations marks secured in the previous attempt(s) for the re-registered courses shall stand cancelled.

#### **24. Amendments to Regulations:**

The Academic Council of SVEC (Autonomous) reserves the right to revise, amend, or change the Regulations, Scheme of Examinations, and / or Syllabi or any other policy relevant to the needs of the society or industrial requirements etc., with the recommendations of the concerned Board(s) of Studies.

#### **25. General:**

The words such as "he", "him", "his" and "himself" shall be understood to include all students irrespective of gender connotation.

**Note:** Failure to read and understand the regulations is not an excuse.

**ANNEXURE-I**

**GUIDELINES FOR DISCIPLINARY ACTION FOR MALPRACTICES /  
IMPROPER CONDUCT IN EXAMINATIONS**

Rule No.	Nature of Malpractices/Improper conduct	Punishment
	<i>If the candidate:</i>	
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the course of the examination)	Expulsion from the examination hall and cancellation of the performance in that course only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that course only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the courses of that Semester. The Hall Ticket of the candidate is to be cancelled.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred for four consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.  The performance of the original candidate who has been impersonated, shall be cancelled in all the courses of the examination (including labs and project work) already appeared and shall not be allowed to appear for examinations of the remaining courses of that semester. The candidate is also debarred for four consecutive semesters from class work and all Semester-end examinations, if his involvement is established. Otherwise, The candidate is debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared

	or answer book or additional sheet, during or after the examination.	including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course only.
6.	Refuses to obey the orders of the Chief Controller of Examinations/Controller of Examinations/any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the Controller of Examinations or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the Controller of Examinations, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the courses of that semester. If the candidate physically assaults the invigilator/Controller of the Examinations, then the candidate is also debarred and forfeits his/her seat. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred for two consecutive semesters from class work and all Semester-end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the courses of that semester. The candidate is also debarred and forfeits the seat.

**Note:** Whenever the performance of a student is cancelled in any course(s) due to Malpractice, he has to register for Semester-end Examinations in that course(s) consequently and has to fulfill all the norms required for the award of Degree.

## **SVEC-19 CURRICULUM**

### **Course Structure for B.Tech Program** (Effective from the Academic year 2019-20 onwards)

#### **ELECTRONICS AND COMMUNICATION ENGINEERING**

<b>Mandatory Induction Program</b>	<b>03 weeks duration</b>
Induction program offered before commencement of the I-Semester course work	Physical activity
	Creative Arts
	Universal Human Values
	Literary
	Proficiency Modules
	Lectures by Eminent People
	Visits to local Areas
	Familiarization to Department/Branch and Innovations

**Course Structure**  
**Electronics and Communication Engineering**  
**I B.Tech. – I Semester**

Sl. No.	Subject Code	Course Title	Contact Periods per week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	19BT1BS01	Differential Equations and Multivariable Calculus	3	1	-	4	4	40	60	100
2.	19BT1BS02	Biology for Engineers	2	-	-	2	2	40	60	100
3.	19BT1BS03	Engineering Physics	3	-	-	3	3	40	60	100
4.	19BT10341	Basic Civil and Mechanical Engineering	3	-	-	3	3	40	60	100
5.	19BT10201	Basic Electrical and Electronics Engineering	3	-	-	3	3	40	60	100
6.	19BT1BS31	Engineering Physics Lab	-	-	2	2	1	50	50	100
7.	19BT10231	Basic Electrical and Electronics Engineering Lab	-	-	2	2	1	50	50	100
8.	19BT20331	Engineering Workshop	-	-	2	2	1	50	50	100
<b>Total:</b>			<b>14</b>	<b>1</b>	<b>6</b>	<b>21</b>	<b>18</b>	<b>350</b>	<b>450</b>	<b>800</b>
9.	19BT1AC01	Spoken English	2	-	-	2	-	-	-	-

**I B.Tech. – II Semester**

Sl. No.	Subject Code	Course Title	Contact Periods per week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	19BT2BS01	Transformation Techniques and Linear Algebra	3	1	-	4	4	40	60	100
2.	19BT1BS04	Engineering Chemistry	3	-	-	3	3	40	60	100
3.	19BT1HS01	Communicative English	3	-	-	3	3	40	60	100
4.	19BT10501	Programming for Problem Solving	3	1	-	4	4	40	60	100
5.	19BT20241	Network Analysis	3	1	-	4	4	40	60	100
6.	19BT1BS32	Engineering Chemistry Lab	-	-	2	2	1	50	50	100
7.	19BT1HS31	Communicative English Lab	-	-	2	2	1	50	50	100
8.	19BT10331	Computer Aided Engineering Drawing	-	1	2	3	2	50	50	100
9.	19BT10531	Programming for Problem Solving Lab	-	-	2	2	1	50	50	100
10.	19BT20251	Network Analysis Lab	-	-	2	2	1	50	50	100
<b>Total:</b>			<b>15</b>	<b>4</b>	<b>10</b>	<b>29</b>	<b>24</b>	<b>450</b>	<b>550</b>	<b>1000</b>

## **II B.Tech.– I Semester**

Sl. No.	Subject Code	Course Title	Contact Periods per week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	19BT3BS02	Special Functions and Complex Analysis	3	1	-	4	4	40	60	100
2.	19BT30401	Electromagnetic Fields and Transmission Lines	3	1	-	4	4	40	60	100
3.	19BT30402	Electronic Devices and Circuits	3	-	-	3	3	40	60	100
4.	19BT30403	Signals and Systems	3	-	-	3	3	40	60	100
5.	19BT30404	Switching Theory and Logic Design	3	-	-	3	3	40	60	100
6.	19BT3HS31	Soft Skills Lab	-	-	2	2	1	50	50	100
7.	19BT30431	Electromagnetic Fields and Transmission Lines Lab	-	-	2	2	1	50	50	100
8.	19BT30432	Electronic Devices and Circuits Lab	-	-	2	2	1	50	50	100
9.	19BT30433	Signals and Systems Lab	-	-	2	2	1	50	50	100
<b>Total:</b>			<b>15</b>	<b>2</b>	<b>8</b>	<b>25</b>	<b>21</b>	<b>400</b>	<b>500</b>	<b>900</b>
10.	19BT3MC01	Environmental Science	2	-	-	2	-	40	-	40

## **II B.Tech. – II Semester**

Sl. No.	Subject Code	Course Title	Contact Periods per week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	19BT50201	Control Systems	3	-	-	3	3	40	60	100
2.	19BT40401	Analog Communications	3	-	-	3	3	40	60	100
3.	19BT40402	Electronic Circuit Analysis and Design	3	1	-	4	4	40	60	100
4.	19BT40403	Linear and Digital IC Applications	3	-	-	3	3	40	60	100
5.	19BT40404	Probability and Stochastic Processes	3	-	-	3	3	40	60	100
6.	<b>Open Elective – 1</b>		3	-	-	3	3	40	60	100
7.	19BT40431	Digital Design Workshop	-	-	2	2	1	50	50	100
8.	19BT40432	Electronic Circuit Analysis and Design Lab	-	-	2	2	1	50	50	100
9.	19BT40433	Linear and Digital IC Applications Lab	-	-	2	2	1	50	50	100
<b>Total:</b>			<b>18</b>	<b>1</b>	<b>6</b>	<b>25</b>	<b>22</b>	<b>390</b>	<b>510</b>	<b>900</b>
10.	19BT315AC	Design Thinking	2	-	-	2	-	-	-	-

### III B.Tech. – I Semester

Sl. No.	Subject Code	Course Title	Contact Periods per week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	19BT50401	Digital Communications	3	-	-	3	3	40	60	100
2.	19BT50402	Digital Signal Processing	3	-	-	3	3	40	60	100
3.	19BT50403	VLSI Design	3	-	-	3	3	40	60	100
Professional Elective-1			3	-	-	3	3	40	60	100
4.	19BT50404	Electronic Measurements and Instrumentation								
	19BT50405	Fiber Optic Communications								
	19BT50406	FPGA Architectures and Applications								
	19BT50407	Radar Engineering								
5.	Open Elective-2		3	-	-	3	3	40	60	100
Inter Disciplinary Elective-1			3	-	-	3	3	40	60	100
6.	19BT50207	Computer Organization and Architecture								
	19BT40501	Computer Networks								
	19BT21501	Object Oriented Programming Through Java								
	19BT50408	Microelectromechanical Systems								
7.	19BT61531	Internet of Things Lab	-	1	2	3	2	50	50	100
8.	19BT50431	Analog and Digital Communications Lab	-	-	2	2	1	50	50	100
9.	19BT50432	Socially Relevant Project-I	-	-	-	-	1	50	50	100
Total:			18	1	4	23	22	390	510	900
10.	19BT503AC	Foundations of Entrepreneurship	2	-	-	2	-	-	-	-



### **III B.Tech. – II Semester**

Sl. No.	Subject Code	Course Title	Contact Periods per week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	19BT6HS01	Principles of Business Economics and Accountancy	3	-	-	3	3	40	60	100
2.	19BT60401	Antennas and Propagation	3	-	-	3	3	40	60	100
3.	19BT60402	Microcontrollers	3	-	-	3	3	40	60	100
<b>Professional Elective-2</b>										
4.	19BT60403	Advanced Digital Signal Processing	3	-	-	3	3	40	60	100
	19BT60404	ARM and AVR Microcontrollers								
	19BT60405	Digital IC Design								
	19BT60406	Satellite Communications								
<b>Professional Elective-3</b>										
5.	19BT60407	Image Processing	3	-	-	3	3	40	60	100
	19BT60408	Nanostructures and Nanotechnology								
	19BT60409	Testing and Testability								
	19BT60410	Wireless Sensor Networks								
<b>Inter Disciplinary Elective-2</b>										
6.	19BT60502	Machine Learning	3	-	-	3	3	40	60	100
	19BT60201	Power Electronics								
	19BT60503	Cryptography and Network Security								
	19BT51041	PLC and SCADA								
7.	19BT60431	Digital Signal Processing Lab	-	-	2	2	1	50	50	100
8.	19BT60432	Microcontrollers Lab	-	-	2	2	1	50	50	100
9.	19BT60433	Socially Relevant Project-II	-	-	-	-	1	50	50	100
<b>Total:</b>			<b>18</b>	<b>-</b>	<b>4</b>	<b>22</b>	<b>21</b>	<b>390</b>	<b>510</b>	<b>900</b>
10.	19BT5MC01	Universal Human Values	2	-	-	2	-	40	-	40

### **IV B.Tech. – I Semester**

Sl. No.	Subject Code	Course Title	Contact Periods per week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	19BT6HS02	Organizational Behavior	3	-	-	3	3	40	60	100
2.	19BT70401	Embedded Systems	3	-	-	3	3	40	60	100
3.	19BT70402	Microwave Engineering	3	-	-	3	3	40	60	100
<b>Professional Elective-4</b>										
4.	19BT71001	Biomedical Instrumentation	3	-	-	3	3	40	60	100
	19BT70403	Analog IC Design								
	19BT70404	Cellular and Mobile communications								
	19BT70405	Speech Processing								
<b>Professional Elective-5</b>										
5.	19BT70406	Adaptive Signal Processing	3	-	-	3	3	40	60	100
	19BT70407	Error Control Coding								
	19BT70408	Low Power CMOS VLSI Design								
	19BT70409	Real Time Systems								
6.	19BT7MOOC	MOOC	-	-	-	-	3	-	100	100
7.	19BT70431	Antennas and Microwave Engineering Lab	-	-	2	2	1	50	50	100
8.	19BT70432	Embedded Systems Lab	-	-	2	2	1	50	50	100
9.	19BT70433	Internship	-	-	-	-	2	-	100	100
<b>Total:</b>			<b>15</b>	<b>-</b>	<b>4</b>	<b>19</b>	<b>22</b>	<b>300</b>	<b>600</b>	<b>900</b>
10.	19BT704AC	Principles of Operating Systems	2	-	-	2	-	-	-	-

#### **IV B.Tech. – II Semester**

Sl. No.	Subject Code	Course Title	Contact Periods per week				C	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
1.	19BT80431	Project Work	-	-	-	-	10	100	100	200
<b>Total:</b>			-	-	-	-	<b>10</b>	<b>100</b>	<b>100</b>	<b>200</b>

#### **LIST OF COURSES FOR OPEN ELECTIVE-1 and OPEN ELECTIVE-2**

<b>Course Code</b>	<b>Open Elective -1</b>	<b>Course Code</b>	<b>Open Elective -2</b>
19BT4BS01	Material Science	19BT4HS01	Banking and Insurance
19BT4HS02	Business Communication and Career Skills	19BT4HS03	Cost Accounting and Financial Management
19BT4HS04	Entrepreneurship for Micro, Small and Medium Enterprises	19BT4HS05	Gender and Environment
19BT4HS06	German Language	19BT4HS07	Indian Economy
19BT4HS08	Indian History	19BT4HS09	Life Skills
19BT4HS10	Personality Development	19BT4HS11	Professional Ethics
19BT4HS12	Women Empowerment	19BT4HS13	Indian Tradition and Culture
19BT4HS14	Constitution of India	19BT40106	Disaster Mitigation and Management
19BT40205	Reliability and Safety Engineering	19BT40107	Sustainable Engineering
19BT50107	Environmental Pollution and Control	19BT40108	Contract Laws and Regulations
19BT50108	Planning for Sustainable Development	19BT40306	Global Strategy and Technology
19BT50109	Rural Technology	19BT40307	Management Science
19BT50505	Ethical Hacking	19BT40504	Cyber Laws and Security
19BT51207	AI in Healthcare	19BT50208	Intellectual Property Rights
19BT51506	Bioinformatics	19BT50409	Green Technologies

## **HONORS DEGREE and MINOR DEGREE**

In addition to the Major Degree, Students have an opportunity to pursue either Minor Degree or Honors Degree as per the eligibility criteria mentioned in Academic Regulations Point No.: 14 & 15.

**Honors Degree:** Honors degree is awarded to the students who have undergone additional learning for 18 credits in the same discipline.

### **HONORS DEGREE IN ELECTRONICS AND COMMUNICATION ENGINEERING**

Semester	Course code	Course title	Contact Periods per week			C	Scheme of Examination Max. Marks		
			L	T	P		Int. Marks	Ext. Marks	Total Marks
III B.Tech I-Sem. (2 Theory)	19BT50410	ASIC Design	3	-	-	3	40	60	100
	19BT50411	Data communications and networks	3	-	-	3	40	60	100
	19BT50412	Detection and Estimation of Signals	3	-	-	3	40	60	100
	19BT50413	Physical Design Automation	3	-	-	3	40	60	100
III B.Tech II-Sem. (2 Theory)	19BT60411	Advanced Digital Communication Systems	3	-	-	3	40	60	100
	19BT60412	Audio signal processing	3	-	-	3	40	60	100
	19BT60413	Network-on-Chip Design	3	-	-	3	40	60	100
	19BT60414	RF IC Design	3	-	-	3	40	60	100
IV B.Tech I-Sem. (2 Theory)	19BT70410	Advanced Wireless Communications	3	-	-	3	40	60	100
	19BT70411	Optical networks	3	-	-	3	40	60	100
	19BT70412	Pattern Recognition	3	-	-	3	40	60	100
	19BT70413	VLSI Signal Processing	3	-	-	3	40	60	100

**Minor Degree:** Minor degree is awarded to the students who have undergone additional learning for 18 credits in any discipline other than parent discipline.

### **MINOR DEGREES OFFERED UNDER SVEC-19 REGULATIONS**

Offering Department	Title of the Minor	Students of Eligible Branches
CSE	Artificial Intelligence and Machine Learning	All branches except CSE, IT and CSSE
IT	Internet of Things	All branches except IT
CSSE	Cyber Security	All branches except CSE, IT and CSSE
ECE	VLSI and Embedded Systems	All branches except ECE
EEE	Power Systems and Drives	All branches except EEE
EIE	Instrumentation and Control Engineering	All branches except EIE
ME	Robotics	All branches except ME
CE	Sustainable Engineering	All branches except CE

## I B. Tech. - I Semester

### (19BT1BS01) DIFFERENTIAL EQUATIONS AND MULTIVARIABLE CALCULUS

(Common to CE, ME, EEE, ECE, EIE, CSE, CSSE and IT)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	1	-	4

#### PRE-REQUISITES: -

**COURSE DESCRIPTION:** Ordinary Differential Equations; Partial Differential Equations; Multivariable Calculus (Differentiation); Multivariable Calculus (Integration); Multivariable Calculus (Vector Calculus).

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Formulate and solve differential equations by applying knowledge of calculus for engineering problems.
- CO2: Demonstrate knowledge in multivariable calculus for evaluating multiple integrals through techniques of integration.
- CO3: Identify scalar and vector valued functions and evaluate vector integrals through knowledge of vector integral theorems and techniques.

#### DETAILED SYLLABUS:

##### UNIT-I: ORDINARY DIFFERENTIAL EQUATIONS (09 Periods)

Second and higher order linear differential equations with constant coefficients: Non-Homogeneous equations with R.H.S terms of the type  $e^{ax}$ ,  $\sin ax$ ,  $\cos ax$ , polynomials in  $x$ ,  $e^{ax}V(x)$  and  $xV(x)$ ; method of variation of parameters; Equations reducible to linear differential equations with constant coefficients: Cauchy's and Legendre's linear equations; Applications to L-C-R Circuit problems.

##### UNIT-II: PARTIAL DIFFERENTIAL EQUATIONS (09 Periods)

Formation of PDE, solutions of first order linear and non-linear PDEs, Solution to homogenous and non-homogenous linear partial differential equations of second and higher order by complimentary function and particular integral method, method of separation of variables in Cartesian coordinates.

##### UNIT-III: MULTIVARIABLE CALCULUS (DIFFERENTIATION) (09 Periods)

Partial derivatives, Chain rule, Total derivative, Jacobian, Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.

##### UNIT- IV: MULTIVARIABLE CALCULUS (INTEGRATION) (09 Periods)

Evaluation of Double integrals (Cartesian and polar coordinates), Change of order of integration (Cartesian form only); Evaluation of Triple integrals; Change of variables: double integration from Cartesian to polar coordinates, Triple integration from Cartesian to spherical and cylindrical polar coordinates; Areas enclosed by plane curves.

**UNIT-V: MULTIVARIABLE CALCULUS (VECTOR CALCULUS) (09 Periods)**

**Vector Differentiation:** Scalar and Vector fields: Gradient of a scalar field, directional derivative, divergence of a vector field, solenoidal vector, curl of a vector field, irrotational vector, Laplacian operator. **Vector Integration:** Line integral-circulation-work done, Surface integral-flux and Volume integral; Vector integral theorems: Theorems of Green, Gauss and Stokes (without proofs).

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M.V.S.S.N. Prasad, *Engineering Mathematics, vol-1*, S. Chand and Company, 13<sup>th</sup> edition, 2014.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44<sup>th</sup> edition, 2017.

**REFERENCE BOOKS:**

1. Dennis G. Zill and Warren S. Wright, *Advanced Engineering Mathematics*, Jones and Bartlett, 6<sup>th</sup> edition, 2011.
2. R. K. Jain and S. R. K. Iyengar, *Advanced Engineering Mathematics*, Alpha Science International Ltd., 6<sup>th</sup> edition, 2017.

**I B. Tech - I Semester**  
**(19BT1BS02) BIOLOGY FOR ENGINEERS**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	2	-	-	2

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Living Organisms; Proteins, Nucleic acids and Enzymes; Genetics and Molecular Biology; Recombinant DNA technology; Human Physiology and Applied Biology.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the basic knowledge of biology to understand the significance of various biological techniques.
- CO2: Identify the role of DNA in the molecular basis of information transfer and understand single gene disorders related to the health perspective.
- CO3: Apply the basic knowledge of bio-analytical devices and methods to assess health issues.

**DETAILED SYLLABUS:**

**UNIT-I: LIVING ORGANISMS (06 Periods)**

Comparison of biological organisms with man-made systems, Classification of living organisms, Cellular basis of life, differences between prokaryotes and eukaryotes, classification on the basis of carbon and energy sources, molecular taxonomy

**UNIT-II: PROTEINS, NUCLEIC ACIDS AND ENZYMES (06 Periods)**

Biomolecules, structure and functions of proteins and nucleic acids, Industrial applications of enzymes, Fermentation and its industrial applications

**UNIT-III: GENETICS AND MOLECULAR BIOLOGY (06 Periods)**

Mendel's laws, single gene disorders in humans, Genetic code, DNA replication, Transcription, Translation.

**UNIT-IV: RECOMBINANT DNA TECHNOLOGY (06 Periods)**

Recombinant DNA Technology: recombinant vaccines, transgenic microbes, plants and animals, animal cloning, biosensors, biochips.

**UNIT-V: HUMAN PHYSIOLOGY AND APPLIED BIOLOGY (06 Periods)**

Fundamentals of Human physiology, neurons, synaptic and neuromuscular junctions, Introduction to EEG, DNA fingerprinting, DNA Micro array and Genomics.

**Total Periods: 30**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Rajiv Singal, Gaurav Agarwal, *Biology for Engineers*, CBS, 2019.
2. S. Sing and T. Allen, *Biology for Engineers*, Vayu Education of India, 2014.

**REFERENCE BOOKS:**

1. B. Alberts, A. Johnson et al., *The molecular biology of the cell*, Garland Science, 6<sup>th</sup> edition, 2014.
2. A. T. Johnson, *Biology for Engineers*, CRC press, 2011.

**ADDITIONAL LEARNING RESOURCES:**

1. Structure and function of Proteins: <https://nptel.ac.in/courses/104102016/16>
2. Enzyme catalysis:  
<https://nptel.ac.in/courses/103103026/module3/lec35/4.html>
3. Biochips: <https://nptel.ac.in/courses/112104029/3>



**I B. Tech. - I Semester**  
**(19BT1BS03) ENGINEERING PHYSICS**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Wave Optics; Electromagnetic Waves; Fiber Optics; Semiconductors; Dielectrics; Magnetism; Superconductors and Nanomaterials

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the knowledge of light waves to interpret the concepts of Interference, Diffraction and Polarization
- CO2: Demonstrate the concepts of electromagnetic wave propagation in an Optical fibers.
- CO3: Apply the basic knowledge of semiconductors to understand the functioning of various optoelectronic devices.
- CO4: Demonstrate the basic knowledge of dielectric and magnetic properties to understand the various dielectric polarizations and magnetic materials.
- CO5: Understand the concepts of superconductors and nanomaterials to familiarize their applications in relevant fields.

**DETAILED SYLLABUS:**

**UNIT-I: WAVE OPTICS**

**(09 Periods)**

Interference: Principle of superposition - Interference of light - Theory of interference fringes - Conditions for sustained interference - Interference in thin films (reflected light) - Newton's rings - Determination of wavelength.

Diffraction: Fraunhofer diffraction - Single slit diffraction - Diffraction grating - Grating spectrum - Determination of wavelength.

Polarization: Polarization by reflection, refraction and double refraction - Nicol's prism - Half wave and Quarter wave plate - Engineering applications of interference, diffraction and polarization.

**UNIT-II: ELECTROMAGNETIC WAVES AND FIBER OPTICS**

**(10 Periods)**

Divergence, Curl of Electric and Magnetic Fields - Maxwell's Equations (qualitative)- Electromagnetic wave propagation (conducting and non conducting media).

Introduction to fiber optics - Total Internal Reflection - Critical angle of propagation - Acceptance angle, Acceptance cone - Numerical Aperture - Classification of fibers based on Refractive index profile, modes - Attenuation losses - Dispersion - Propagation of electromagnetic wave through optical fiber - Block diagram of fiber optic communication - Applications of an optical fiber - Fiber optic Sensors (temperature, displacement).

### **UNIT-III: SEMICONDUCTORS**

**(10 Periods)**

Origin of energy bands - Classification of solids based on energy bands - Intrinsic semiconductors - Density of electrons in intrinsic semiconductor - Density of holes in intrinsic semiconductor (qualitative) - Intrinsic carrier concentration - Fermi energy - Electrical conductivity of intrinsic semiconductors - Extrinsic semiconductors - Density of charge carriers in n-type - Density of charge carriers in p-type (qualitative) - Direct and Indirect band gap semiconductors - Hall effect, Hall coefficient - Applications of Hall effect - Drift and Diffusion currents -pn junction - Semiconducting materials for optoelectronic devices : Photodiode and Semiconductor diode laser.

### **UNIT-IV: DIELECTRICS AND MAGNETISM**

**(09 Periods)**

Introduction to dielectrics - Electric polarization - Dielectric polarizability, susceptibility and dielectric constant - Types of polarizations (qualitative) - Frequency dependence of polarization - Lorentz (internal) field - Dielectric break down - Piezoelectricity - Applications of dielectrics.

Introduction to magnetics - Magnetic dipole moment, magnetization, magnetic susceptibility and permeability - Origin of magnetic moment - Classification of magnetic materials - Hysteresis loop - Soft and hard magnetic materials.

### **UNIT-V: SUPERCONDUCTORS AND NANOMATERIALS**

**(07 Periods)**

Introduction to Superconductors, Properties - Critical parameters of Superconductors - Meissner effect - Penetration depth - Types of Superconductors - BCS Theory - Josephson effect (AC & DC) - High  $T_c$  Superconductors - Applications.

Basic principles of nanomaterials - Synthesis of nanomaterials by PLD method - Properties of nanomaterials (Electrical, Magnetic, Optical and Mechanical) - Applications of nanomaterials.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. M. N. Avadhanulu, P. G. Kshirsagar & T.V. S. Arun Murthy, *A Text book of Engineering Physics*, S. Chand Publications, 11<sup>th</sup> edition, 2019.
2. P. K. Palaniswamy, *Engineering Physics*, Scitech Publications India Private Limited, 2<sup>nd</sup> edition, 2009.

#### **REFERENCE BOOKS:**

1. K. Thyagarajan, *Engineering Physics*, McGraw-Hill Education (India) Pvt. Ltd, 2016.
2. R. K. Gaur and S. L. Gupta, *Engineering Physics*, Dhanpat Rai Publications (P) Ltd, 2015.

**I B. Tech. - I Semester**  
**(19BT10341) BASIC CIVIL AND MECHANICAL ENGINEERING**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Overview of Civil Engineering; Surveying, Civil Engineering Materials, Mechanics of Materials, Building Components, Civil Engineering Infrastructure; Overview of Basic Mechanical Engineering; Internal Combustion Engines and Turbines, Mechanical Power Transmission Systems, Manufacturing Processes, Machining Processes, Non-Conventional Machining.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the basic principles of civil engineering, Techniques and tools for analyzing civil structures and solve related problems.
- CO2: Describe the working of principles of basic mechanical engineering and solve problems related to it.

**DETAILED SYLLABUS:**

**Part-A: CIVIL ENGINEERING**

**UNIT-I: SURVEYING AND CIVIL ENGINEERING MATERIALS (10 Periods)**

**Overview of Civil Engineering:** Civil Engineering contributions to the welfare of society, specialized sub disciplines in Civil Engineering.

**Surveying:** Objectives, classification and principles; Measurements – distances, angles, levels, areas and volumes; contouring; Illustrative examples.

**Civil Engineering Materials:** Bricks, stones, concrete, steel, glass, timber, composite materials.

**Mechanics of Materials:** Forces, system of forces, laws of mechanics, moment of a force, equilibrium, resultant, Internal and External forces, Stress, Strain, Hooke's law and Elasticity.

**UNIT-II: BUILDING COMPONENTS AND CIVIL ENGINEERING INFRASTRUCTURE (08 Periods)**

**BUILDING COMPONENTS:**

**Sub structure** - Types of foundations, Bearing capacity and settlement, Requirement of good foundations.

**Superstructure** - Civil engineering construction - Brick masonry, Stone masonry, Beams, Columns, Lintels, Roofs, Floors, Stairs, Building bye-laws - bye-laws floor area, carpet area and floor space index, basics of interior design and landscaping.

**Civil Engineering Infrastructure** - Types of Bridges and Dams, Water supply and Sanitary systems, Rainwater harvesting, Types of Highways and Railways, Ports and Harbours.

## **Part-B: MECHANICAL ENGINEERING**

### **UNIT-III: INTERNAL COMBUSTION ENGINES, TURBINES AND PUMPS**

**(09 Periods)**

**Overview of Mechanical Engineering:** Introduction to Mechanical Engineering, specialized sub disciplines in Mechanical Engineering.

**Internal Combustion Engines** - Classification – Working principle of Petrol and Diesel Engines – Four stroke and two stroke engines – Comparison of four stroke and two stroke engines.

**Turbines and Pumps** – Classifications of Steam turbines - Impulse turbine, Reaction turbines; Working principle of Reciprocating Pumps (single acting and double acting) and Centrifugal Pumps.

### **UNIT-IV: MECHANICAL POWER TRANSMISSION SYSTEMS**

**(09 Periods)**

**Power Transmission Systems:** Belt, rope and chain drives, Gears and Transmission screw

**Power transmission by belts:** Classification of belts, Length of the Belt (Open and Crossed-Belt Drives), Power Transmitted by Belt Drive, Tension due to Centrifugal Forces, Initial Tension, Maximum Power Transmitted.

**Power transmission by Gear train:** Gear terminology, Classification of gears, Gear train- Simple Gear Train and Compound Gear Train, Power Transmitted by Simple Gear Train.

### **UNIT-V: MANUFACTURING PROCESSES**

**(09 Periods)**

**Manufacturing processes:** Elementary ideas of Casting, Forging, Rolling, Welding, Soldering and Brazing.

**Machining processes-** Lathe-Turning, Taper turning, Thread cutting, Shaping, Drilling, Grinding, Milling (simple sketches and short notes).

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

#### **TEXTBOOKS:**

1. Shanmugam G. and Palanichamy M.S., *Basic Civil and Mechanical Engineering*, Tata McGraw Hill Publishing Co., New Delhi, 1<sup>st</sup> edition 2018.
2. R. Vaishnavi, M. Prabhakaran & V. Vijayan, *Basic Civil and Mechanical Engineering*, S.CHAND Publications, 2<sup>nd</sup> edition, 2013.
3. B.C Punmia, Ashok Kumar Jain, Arun kumar Jain, *Surveying (vol-I)*, Laxmi publications, 16<sup>th</sup> edition, 2005.
4. B. C Punmia, Ashok Kumar Jain, Arun kumar Jain, *Building Construction*, Laxmi publications, 10<sup>th</sup> edition, 2008.

#### **REFERENCES:**

1. Seetharaman S., *Basic Civil Engineering*, Anuradha Agencies, 2005.
2. Ramamrutham S., *Basic Civil Engineering*, Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Kalpakjian, Serop, *Manufacturing Engineering and Technology*, Pearson Education, 7<sup>th</sup> edition, 2014.
4. Prabhu .T.J, Jai Ganesh. V and Jebaraj.S, *Basic Mechanical Engineering*, Scitech Publications, Chennai, 2000.
5. Pravin Kumar, *Basic mechanical engineering* Pearson Education, 1<sup>st</sup> edition, 2013.

**I B. Tech. – I Semester**  
**(19BT10201) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Principles of Electrical Systems; AC Machines; Semiconductor Devices and Op-Amps.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze electrical circuits by applying the conceptual knowledge of circuit elements.
- CO2: Demonstrate knowledge on various generation technologies, protection devices, safety procedures and BEE standards.
- CO3: Demonstrate knowledge on characteristics and applications of transformers and AC machines.
- CO4: Demonstrate knowledge on characteristics and applications of diode, BJT and Op-amps.

**DETAILED SYLLABUS:**

**UNIT-I: PRINCIPLES OF ELECTRICAL SYSTEMS-I (09 Periods)**

Basic electrical sources: DC-Battery, AC sources–Single loop generator; Single phase and three phase supply; Electrical circuit elements (R, L and C), Ohm's law, Kirchhoff's laws, Representation of sinusoidal waveforms, peak and RMS values, phasor representation, reactive power, apparent power, real power, energy and power factor.

**UNIT-II: PRINCIPLES OF ELECTRICAL SYSTEMS-II (09 Periods)**

Significance of Power factor and power factor correction, most economical power factor. Typical layout of electrical grid; Typical layout and operation of Hydro, Thermal and Solar Power Plants; Fuse, circuit breaker (MCB, MCCB, RCCB, ELCB), relay (elementary treatment); Inverter and UPS (block diagram approach only). Earthing – importance of earthing, pipe earthing and plate earthing; Safety measures. Energy Efficiency (Star rating) standards by BEE.

**UNIT-III: TRANSFORMERS AND AC MACHINES (09 Periods)**

Construction and working of a single phase transformer, EMF Equation; Construction and working of three phase induction motor, torque equation, torque-slip characteristics, applications; construction and working of a resistor start & capacitor start and run single phase induction motor, applications; Construction and working of synchronous machine, applications.

**UNIT-IV: SEMICONDUCTOR DEVICES****(10 Periods)**

PN Junction diode, Characteristics, applications - half wave and full wave rectifier. Zener diode, characteristics, application-Regulator. BJT- operation, configurations, characteristics, applications - switch and amplifier.

**UNIT-V: OP-AMPS****(08 Periods)**

Operational Amplifier: Block diagram of Op-Amp, equivalent circuit, Op-Amp AC and DC Characteristics, Inverting and Non-Inverting modes. Applications - Adder, Comparator, Integrator and Differentiator.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Ashfaq Hussain, *Fundamentals of Electrical Engineering*, Dhanpatrai & Co. (P) Ltd., 3<sup>rd</sup> edition, New Delhi, 2009.
2. R. L. Boylestad and Louis Nashelsky, *Electronics Devices and Circuits*, PHI, 11<sup>th</sup> edition, 2009.

**REFERENCE BOOKS:**

1. M.S. Naidu, S. Kamakshaiah, *Introduction to Electrical Engineering*, Tata McGraw-Hill Education, New Delhi, 2007.
2. D. Roy Chowdhury, *Linear Integrated Circuits*, New Age International Pvt. Ltd., 4<sup>th</sup> edition, 2011.

**I B. Tech. - I Semester**  
**(19BT1BS31) ENGINEERING PHYSICS LAB**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Determination of wavelength of light and thickness of a thin film; numerical aperture and acceptance angle of optical fiber; Characteristics of various semiconductor diodes; Resistivity of semiconductor; magnetic field along axial line of a current carrying coil

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the basic knowledge of light waves and semiconductors to demonstrate the functioning of optoelectronic devices.
- CO2: Understand the experimental procedures to calculate the thickness of a thin film, Hall coefficient, Hysteresis losses, and acceptance angle of an optical fiber.
- CO3: Determine the experimental values of magnetic field induction, wave length of a light source, energy gap of a semiconductor.
- CO4: Apply skills to plot characteristic curves to determine the various parameters of semiconductor diodes.
- CO5: Work independently and in teams to solve problems with effective communication.

**List of Engineering Physics Experiments:**

A minimum of any **Ten** experiments are to be conducted among the following:

1. Determine the thickness of the wire using wedge shape method.
2. Determination of wavelength of light source by Newton's ring method.
3. Determination of wavelength by plane diffraction grating method.
4. Estimation of magnetic field along the axis of a circular coil carrying current.
5. Study the variation of Magnetic field induction (B) vs Magnetic field strength (H) by magnetizing the magnetic material (B-H Curve).
6. Determination the numerical aperture of a given optical fiber and hence to estimate its acceptance angle.
7. Determination of number of charge carriers and Hall coefficients of a given semiconductor using Hall Effect.
8. Determine the resistivity of semiconductor by Four probe method.
9. Determine the energy gap of a semiconductor.
10. Study the I-V characteristics of pn junction diode.
11. Estimation of threshold voltages of different LED's.
12. Study the characteristics of Photodiode.
13. Determination of wavelength of laser by using diffraction grating.

**REFERENCES:**

1. S. Balasubramaniah and M.N. Srinivasan, *A Text book of practical physics*, S Chand Publications, 2017.
2. <http://vlab.amrita.edu/index.php> - Virtual Labs, Amrita University.

**I B. Tech. - I Semester**  
**(19BT10231) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

**PRE-REQUISITES:** Physics at intermediate level.

**COURSE DESCRIPTION:** Practical investigations on Electrical circuits, AC Machines, Semiconductor Devices and Op-Amps.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze, measure, interpret and validate the practical observations by applying the fundamental knowledge of electrical circuits, machines and electronic devices.
- CO2: Design Op-amp based amplifier, voltage summer and integrator circuits for desired specifications.
- CO3: Work independently and in teams to solve problems with effective communication.

**List of Experiments:**

Minimum **Ten** experiments are to be conducted.

1. Measurement of electrical quantities (AC & DC) using Voltmeter, Ammeter and Wattmeter.
2. Verification of Ohm's law and Kirchhoff's laws.
3. Circuit
  - (a) with one lamp controlled by one switch and provision of 2-pin or 3-pin socket PVC surface conduit system.
  - (b) With two lamps controlled by two switches with PVC surface conduit system.
  - (c) for Stair case wiring and Godown wiring.
4. Measurement of Power factor and it's improvement.
5. Load test on 1-Phase Transformer.
6. Brake test on 3-Phase Induction Motor.
7. Brake test on 1- phase induction motor.
8. VI Characteristics of PN and Zener Diodes.
9. Ripple factor and load regulations of rectifier with and without filters.
10. Input and output characteristics of CE configuration.
11. Design of inverting and non-inverting amplifiers using op-amp.
12. Design of voltage summer and integrator using op-amp.
13. Soldering practice.

**REFERENCES BOOKS/ LAB MANUALS:**

1. P. S. Dhogal, *Basic Practicals in Electrical Engineering*, Standard Publishers, 2004.
2. YannisTsivdis, *A First Lab in Circuits and Electronics*, Wiley, 1<sup>st</sup> edition., 2001



**ADDITIONAL LEARNING RESOURCES:**

1. [www.vlab.co.in](http://www.vlab.co.in), Virtual Electric Circuits Lab, A initiative of MHRD under NMEICT.
2. [www.vlab.co.in](http://www.vlab.co.in), Basic Electronics Lab, A initiative of MHRD under NMEICT.
3. <https://nptel.ac.in/courses/117106108/>
4. <https://ocw.mit.edu/high-school/physics/exam-prep/electric-circuits/>
5. <https://nptel.ac.in/courses/108105017/>
6. <https://nptel.ac.in/courses/108108112/>
7. <https://nptel.ac.in/courses/117107094/>

**I B. Tech. - I Semester**  
**(19BT20331) ENGINEERING WORKSHOP**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Knowledge on various workshop hand and power tools; hands on experience in different manufacturing trades such as fitting, carpentry, sheet metal forming and foundry; Demonstration on dismantling and assembling of various two wheeler parts, power tools in machining and metal joining, basics of plumbing and working of 3D printer.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design and model various basic prototypes in the trade of fitting such as square/half round mating, V- mating and dovetail mating from the given MS work pieces using fitting tools.
- CO2: Develop different prototypes in the carpentry trade such as cross lap joint, dovetail / bridle joints and Mortise and Tenon joint using carpentry tools.
- CO3: Design and model different prototypes in the sheet metal forming trade such as rectangular tray, square vessel/cylinder, Funnel as per the dimensions using sheet metal forming tools.
- CO4: Develop sand mold using single piece pattern and split piece pattern in the foundry trade using foundry tools.
- CO5: Demonstrate the knowledge on automobile parts, power tools, plumbing operation, 3D printing technology involved in different engineering applications.
- CO6: Work independently / in groups & communicate effectively in oral and written forms.

**DETAILED SYLLABUS:**

**FITTING:** Conduct a detailed study on various aspects in fitting trade which includes the details of fitting operations, safety precautions, types of tools, tool holders, miscellaneous tools, care and maintenance of hand tools, marking and measurement tool, and finishing tool.

**List of Exercises:**

1. Make a square/half round mating from the given MS work pieces
2. Make a V- mating from the given MS work pieces
3. Make a dovetail mating from the given MS work pieces

**CARPENTRY:** Conduct a detailed study on various aspects in carpentry trade which includes the details of types of wood, carpentry tools, wood working techniques, types of joints, safety precautions, and care and maintenance of tools.

**List of Exercises:**

4. Prepare a cross lap joint
5. Prepare dovetail / bridle joints
6. Prepare a Mortise and Tenon joint.
- 7.

**SHEET METAL FORMING:** Conduct a detailed study on various aspects in sheet metal forming which includes the details of sheet materials, hand tools, sheet metal fabrication, and safety and precautions

**List of Exercises:**

8. Fabricate a rectangular tray as per the dimensions
9. Fabricate square vessel/cylinder as per the dimensions
10. Fabricate a Funnel as per the dimensions

**FOUNDRY:** Conduct a detailed study on various aspects in foundry which includes the details of moulding sand, properties of moulding sand, types of patterns and pattern, materials, foundry tools, and safety and precautions

**List of Exercises:**

11. Prepare a sand mold, using the given single piece pattern (stepped pulley/cube)
12. Prepare a sand mold, using the given split piece pattern (pipe bent/dumbbell)

**DEMONSTRATION:**

13. Demonstrate the dismantling and assembling of various two wheeler parts
14. Demonstrate the usage of power tools.
15. Demonstrate the plumbing operation and identify the essential tool and materials required for plumbing.
16. Demonstrate the working of 3D printer

Note: Student shall perform any **Twelve Exercises**

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. P. Kannaiah and K. L. Narayana, *Workshop Manual*, SciTech Publishers, 2009.
2. K. Venkata Reddy, *Workshop Practice Manual*, BS Publications, 2008.
3. V. Ramesh Babu, *Engineering Workshop Practice*, V R B Publishers Private Limited, 2009.

**ADDITIONAL LEARNING RESOURCES:**

1. R. K. Jain, *Production Technology*, Khanna Publishers, 17<sup>th</sup> edition, 2012.
2. Kalpakjian, Serop, *Manufacturing Engineering and Technology*, Pearson Education, 7<sup>th</sup> edition, 2014.

**I B. Tech. - I Semester**  
**(19BT1AC01) SPOKEN ENGLISH**  
 (Audit Course)  
 (Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
-	-	-	2	-	-	-

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Functional English; Vocabulary Building; Functional Grammar-I; Functional Grammar – II; Communication Skills.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate knowledge of grammar and vocabulary in writing effective formal letters and e-mails.
- CO2. Communicate effectively by applying appropriate speaking and writing techniques by examining and applying functional English.

**DETAILED SYLLABUS:**

**UNIT-I: FUNCTIONAL ENGLISH: (06 Periods)**

Introduction - Functional Spoken English; Just a Minute; **Listening – Speaking:** Do's and Don'ts; **Expressing:** Ability/ Admiration/ Agreement/ Anger/ Annoyance/ Appreciation/ Pleasure/ Sarcasm/ Satisfaction/ Surprise/ Approval/ Capability/ Certainty/ Condolences/ Doubt/ Fear/ Gratitude/ Possibility/ Worry; **Asking for:** Advice/ Clarification/ Direction/ Information/ Permission/ Predictions/ a recommendation

**UNIT-II: VOCABULARY BUILDING: (06 Periods)**

Vocabulary for day-to-day conversations; Introduction: Vegetables/ Groceries/ Fruits/ Weather; Parts of a Human body/ Dresses/ Furniture/ Relations; Birds/ Cries of Animals; Food/ Hospitality/ Houses/ Rooms/ Tools; Airport/ News Paper/ Books/ Gems; Corporate Vocabulary/ Jobs/ Occupations/ Diseases; British/ American spelling; Slang Words and Technical Jargon

**UNIT-III: FUNCTIONAL GRAMMAR - I: (06 Periods)**

English Grammar and the Indian Student; Introduction: Parts of Speech, Verb forms; Tenses; Voice; Speech

**UNIT-IV: FUNCTIONAL GRAMMAR - II: (06 Periods)**

Universal Auxiliaries; Sentence making for an effective communication; Sentence Structure -WH- Questions - How to frame Questions and give answers; Question Tags; Subject and verb agreement; Spotting Errors

**UNIT-V: COMMUNICATION SKILLS:****(06 Periods)**

Polite, Courteous and diplomatic terms; Useful daily expressions; Courtesy, Good manners and Etiquette; Conversation Techniques; Narrating/ Reading/ Listening to stories; Telling Stories

**Total Periods: 30**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. L. Adinarayana and V. Prakasam, *Spoken English*, Neelkamal Publications Pvt. Ltd., New Delhi, 2008
2. Ram Bhasker Raju, *The Complete Book on Spoken English*, Goutham Buddha Publications, Hyderabad, 2002.

**REFERENCE BOOKS:**

1. Sabina Pillai, *Spoken English for my World*, Oxford University Press, New Delhi, 2016.
2. K. R. Lakshminarayanan, *Speak in English*, Scitech Publications, Chennai, 2009.

**ADDITIONAL LEARNING RESOURCES**

- 1..<https://www.britishcouncil.in/programmes/english-partnerships/state/skills-projects/AP-English-Skills>.
2. <https://www.fluentu.com/blog/english/websites-to-learn-english/>

## I B. Tech. - II semester

### (19BT2BS01) **TRANSFORMATION TECHNIQUES AND LINEAR ALGEBRA**

(Common to CE, ME, EEE, ECE, EIE, CSE, CSSE and IT)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	1	-	4

#### **PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Fourier Series and Fourier Transforms; Laplace Transforms; Inverse Laplace Transforms; Linear Algebra-I (Matrices); Linear Algebra-II (Vector Spaces).

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Apply the knowledge of Fourier and Laplace transform techniques to solve differential equations.

CO2: Analyze linear transformations and associated matrices to solve engineering problems by applying the knowledge of linear algebra.

#### **DETAILED SYLLABUS:**

##### **UNIT-I: FOURIER SERIES AND FOURIER TRANSFORMS (09 Periods)**

Fourier series: Determination of Fourier coefficients, Euler's formulae, convergence of Fourier series (Dirichlet's conditions), Fourier series in  $(0, 2l), (-l, l)$ ; Fourier series of even and odd functions; Half-range Fourier sine and cosine expansions in  $(0, l)$ ; Fourier integral theorem (statement only), Fourier sine and cosine integrals; Fourier transforms, Fourier sine and cosine transforms, Inverse Fourier transforms.

##### **UNIT-II: LAPLACE TRANSFORMS (09 Periods)**

Definition of Laplace transform, existence conditions, Laplace transform of standard functions, Properties of Laplace transforms, Laplace transforms of derivatives, Laplace transforms of integrals, multiplication by  $t^n$ , division by  $t$ , Laplace transform of periodic functions, Laplace transforms of unit step function and unit impulse function.

##### **UNIT-III: INVERSE LAPLACE TRANSFORMS (09 Periods)**

Inverse Laplace transform by different methods; Convolution theorem (without proof), inverse Laplace transforms by convolution theorem; Applications of Laplace transforms to ordinary differential equations of first and second order with constant coefficients.

##### **UNIT-IV: LINEAR ALGEBRA-I (MATRICES) (09 Periods)**

Rank of a matrix: echelon form; Linear systems of equations: solving system of Homogeneous and Non-Homogeneous equations; Eigen values and Eigen vectors of a matrix and properties (without proofs), Diagonalization of a matrix by orthogonal transformation; Quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical form by orthogonal transformation.

**UNIT-V: LINEAR ALGEBRA-II (VECTOR SPACES)****(09 Periods)**

Vector spaces, Linear dependence and independence of vectors, basis, dimension, Linear transformations (maps), range and kernel of a linear map, rank and nullity, inverse of a linear transformation, rank-nullity theorem (without proof), matrix associated with a linear map.

**Total Periods: 45*****Topics for Self-Study are provided in the Lesson Plan*****TEXT BOOKS:**

1. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M. V. S. S. N. Prasad, *Engineering Mathematics-II*, S. Chand & Company, 10<sup>th</sup> edition, 2016.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44<sup>th</sup> edition, 2017.
3. David Poole, *Linear Algebra: A Modern Introduction*, Brooks/Cole, 2<sup>nd</sup> edition, 2005.

**REFERENCE BOOKS:**

1. B. V. Ramana, *Higher Engineering Mathematics*, Tata McGraw hill, 1<sup>st</sup> edition, 2017.
2. V.Krishna Murthy, Mainra and Arora: *An Introduction to Linear Algebra*, Affiliated East-West Press, 1993.

**I B. Tech. - II Semester**  
**(19BT1BS04) ENGINEERING CHEMISTRY**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Atomic Structure and Bonding Theories; Water Treatment; Electrochemistry and Applications; Corrosion; Instrumental Methods and Applications; Fuel chemistry and Lubricants.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the basic knowledge of quantum mechanical approach to atomic structure and bonding theories to identify shapes of different orbitals and molecules.
- CO2: Analyze and solve problems associated with hardness of water, boiler troubles and address the societal, health and safety issues related to quality of water.
- CO3: Apply the basic knowledge of corrosion phenomenon to identify solutions for control of corrosion and demonstrate competency in the basic concepts of electrochemical cells.
- CO4: Demonstrate the basic knowledge of instrumental methods and their applications in the structural analysis of materials.
- CO5: Apply the basic knowledge of fuel chemistry and lubricants to identify the quality of fuels and lubricants.

**DETAILED SYLLABUS:**

**UNIT-I: ATOMIC STRUCTURE AND BONDING THEORIES (09 Periods)**

Quantum-mechanical model of atom, Schrodinger wave equation, significance of  $\Psi$  and  $\Psi^2$ , applications to particle in a box and hydrogen atom; Molecular orbital theory – bonding in homo and hetero nuclear diatomic molecules – energy level diagrams of  $N_2$ ,  $O_2$ , NO and CO;  $\Pi$ -molecular orbitals of butadiene and benzene; VSEPR theory and molecular shapes.

**UNIT-II: WATER TREATMENT (09 Periods)**

Introduction, types of water, Impurities in water and their consequences. Hardness of water, units of hardness, disadvantages of hardness, measurement of hardness by EDTA method, numerical problems on measurement of hardness of water, boiler troubles-priming & foaming, scales & sludge, caustic embrittlement, boiler corrosion, softening of water– Ion exchange process, zeolite process, desalination of brackish water by reverse osmosis, Drinking water treatment- Ozonisation& chlorination, specifications of potable water as per WHO and BIS standards. Fluoride in ground water: Effects on human health, defluoridation method – Nalgonda method; merits and demerits of various defluoridation methods.



**UNIT-III: ELECTROCHEMISTRY AND APPLICATIONS****(10 Periods)**

Electrode potential, Nernst equation, reference electrodes (Calomel electrode and glass electrode), electrochemical cell, cell potential calculations. Primary cells – dry cell, alkali metal sulphide batteries, Secondary cells – lead acid, lithium ion batteries, Fuel cells - Hydrogen-oxygen fuel cell, Methanol-oxygen fuel cell, Solid-oxide fuel cell.

**Corrosion:** Introduction, Definition, types of corrosion- wet (galvanic corrosion, concentration cell corrosion) and dry corrosion, Factors influencing corrosion, control of corrosion- sacrificial anodic protection, Impressed current cathodic protection, electroplating method (Nickel).

**UNIT-IV: INSTRUMENTAL METHODS AND APPLICATIONS****(09 Periods)**

Introduction to spectroscopy–types of energy present in molecules, types of spectra, UV-Vis spectroscopy – principle, types of electronic transitions, chromophore, auxochrome, Bathochromic shift, Hypsochromic shift, Instrumentation of UV-Vis spectrophotometer, applications; Infrared spectroscopy – principle, types of vibrational modes, group frequencies, Instrumentation of IR spectrophotometer, applications. principle and applications of physicochemical methods (SEM, TEM, X-ray diffraction).

**UNIT-V: FUEL CHEMISTRY AND LUBRICANTS****(08 Periods)**

**Fuel chemistry:** Types of fuels, calorific value, numerical problems based on calorific value; Liquid fuels, cracking of oils (Thermal and Fixed-bed catalytic cracking), knocking and anti-knock agents, Octane and Cetane values, Synthetic petrol: Fischer-Tropsch method and Bergius process.

**Lubricants:** Definition, functions of lubricants, mechanism of lubrication, classification of lubricants, properties of lubricants – viscosity and viscosity index , flash and fire points, cloud and pour points, Aniline points, neutralization number and mechanical strength.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. P. C. Jain & Monika Jain, *Engineering Chemistry*, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 16<sup>th</sup> edition, 2013.
2. K. N. Jayaveera, G. V. Subba Reddy and C. Ramachandriah, *Engineering Chemistry*, Mc.Graw Hill Publishers, New Delhi.

**REFERENCE BOOKS:**

1. J. D. Lee, *Concise Inorganic Chemistry*, Oxford University Press, 5<sup>th</sup> edition 2010.
2. Skoog and West, *Principles of Instrumental Analysis*, Thomson, 6<sup>th</sup> edition, 2007.
3. Peter Atkins, Julio de Paula and James Keelar, *Atkins' Physical Chemistry*, Oxford University Press, 10<sup>th</sup> edition, 2010.

**I B. Tech. - II Semester**  
**(19BT1HS01) COMMUNICATIVE ENGLISH**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	-	-	3

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to communication; Active listening; Effective speaking; Reading; Technical writing.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge of English language, examining and applying the aspects of Process of communication, Paralinguistic features, Skimming, Scanning, and Elements of style in writing.
- CO2: Analyze the modes and techniques of listening, speaking, reading, writing and apply appropriately to communicate effectively with the engineering community and society.
- CO3: Apply reading and writing techniques in preparing documents by examining SQ3R Technique, Writer's Block, and Précis Writing.
- CO4: Communicate effectively applying appropriate speaking techniques by examining and applying the communication styles in Conferences, Symposia, Seminars and Persuasive Speaking.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO COMMUNICATION (09 Periods)**

Introduction – Language as a Tool of Communication – Communicative Skills (Listening, Speaking, Reading and Writing) – Effective Communication – Modes of Communication– Barriers to Communication (classification) - Case study

**UNIT-II: ACTIVE LISTENING (09 Periods)**

Introduction – Traits of a Good Listener – Listening Modes – Types of Listening – Barriers to Effective Listening – Listening for General Content and Specific Information - Case study

**UNIT-III: EFFECTIVE SPEAKING (09 Periods)**

Introduction – Achieving Confidence, Clarity and Fluency – Paralinguistic Features – Barriers to Speaking – Types of Speaking – Conferences; significance, planning and preparation and procedure – Symposia and Seminars - Persuasive Speaking - Case study

**UNIT-IV: READING (09 Periods)**

Introduction – Reading and Interpretation – Intensive and Extensive Reading – Critical Reading --Techniques for Good Comprehension- SQ3R Reading Technique –Study Skills - Case study

**UNIT- V: TECHNICAL WRITING****(09 Periods)**

Introduction – Language – Elements of Style – Techniques for Good Technical Writing – Paragraphs Construction – Essays: types, Steps to Essay Writing and Checklist – Précis Writing – Case study.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Meenakshi Raman & Sangeetha Sharma, *Technical Communication*, Oxford University Press, New Delhi, 2012.
2. Ashraf Rizvi, *Effective Technical Communication*, McGraw-Hill Education (India) Pvt. Ltd., New Delhi, 2018.

**REFERENCE BOOKS:**

1. Sanjay Kumar & PushpLata, *Communication Skills*, Oxford University Press, New Delhi, 2013.
2. Rajendra Pal and J. S. Korlahalli, *Essentials of Business Communication*, Sultan Chand and Son, New Delhi, 2010.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.skillsyouneed.com/ips/active-listening.html>: A useful summary of what active listening skills are.
2. [https://en.wikipedia.org/wiki/Active\\_listening](https://en.wikipedia.org/wiki/Active_listening): Wikipedia entry about active listening.
3. <https://www.forbes.com/sites/womensmedia/2012/11/09/10-steps-to-effective-listening/#4b27a2503891>: Ten steps to Active Listening (by Forbes magazine).
4. <https://goo.gl/t1Uqrt>: 20 tips for organizing a conference.
5. <https://goo.gl/kPMr9u>: 10 important issues for speakers at a conference.
6. <https://goo.gl/C5bDvv>: Wikihow guide to organizing a conference.

**I B. Tech. – II Semester**  
**(19BT10501) PROGRAMMING FOR PROBLEM SOLVING**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	1	-	4

**PRE-REQUISITES:** A course on Basic Mathematics

**COURSE DESCRIPTION:** Introduction to problem solving approach, Introduction to Python programming, control structures, sequences, sets, Dictionaries, Implementation of Data structures using Python, Modular programming, file handling, Data representation and Visualization.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Demonstrate knowledge on Python constructs to solve basic problems.

CO2: Demonstrate knowledge on Python constructs to solve basic problems.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO PROBLEM SOLVING AND PYTHON PROGRAMMING**

**(10 Periods)**

**Problem Solving Aspect:** top-down design, implementation of algorithms, building blocks of flow charts, program verification and efficiency of algorithms.

**Python Programming:** tokens, literals, identifiers, keywords, special symbols and operators; fundamental data types, expressions, type conversions, handling Input and output in Python.

**UNIT-II: CONTROL STRUCTURES**

**(08 Periods)**

**Selection Statements:** if statement, if-else statement, if-elif-else statement, nested-if statement.

**Iterative Statements:** while loop, for loop, break statement, continue statement, pass and else statements used with loops.

**UNIT-III: SEQUENCES, SETS, DICTIONARIES AND DATA STRUCTURES**

**(09 Periods)**

**Sequences: Lists and operations** - creating, inserting elements, updating elements, deleting elements, searching and sorting, list comprehensions, nested lists; **tuples** - creating, searching and sorting, nested tuples; **strings** - Initializing a string and string operations, string handling methods, string formatting; **sets** - set creation and operations; **dictionaries** - operations on dictionaries, dictionary methods, sorting elements using lambdas.

**Data structures: Stacks** - push, pop, peek and display operations on stack, applications of stack; **Queues** - enqueue, dequeue and display operations on queue, applications of queues.

#### **UNIT-IV: MODULAR PROGRAMMING AND FILE HANDLING (10 Periods)**

**Modular Programming:** need for functions, function definition, function call, variable scope and lifetime, return statement, positional arguments, keyword arguments, default arguments and variable-length arguments, recursive functions; Modules - math, NumPy, date and time.

**File Handling:** types of files, opening and closing files, reading and writing data.

#### **UNIT-V: DATA REPRESENTATION AND VISUALIZATION (08 Periods)**

Pandas: creating data frame, reading data from CSV files, indexing and selecting data, dealing with rows and columns; Visualization - bar plots, histogram, Scatter Plot.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. R. Nageswara Rao, *Core Python Programming*, 2<sup>nd</sup> edition, Dreamtech Press, 2018.
2. R. G. Dromey, *How to solve i\*t by Computer*, Pearson, 2006.

#### **REFERENCE BOOKS:**

1. Reema Thareja, *Python Programming using Problem Solving Approach*, 1<sup>st</sup> edition, Oxford University Press, 2017.
2. Charles Dierbach, *Introduction to Computer Science using Python: A Computational Problem-Solving Focus*, Wiley India, 2016.

**I B. Tech. - II Semester**  
**(19BT20241) NETWORK ANALYSIS**  
(Common to ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	1	-	4

**PRE-REQUISITES:** Physics at Intermediate Level.

**COURSE DESCRIPTION:** Fundamentals of electrical circuits; Analysis of single phase AC circuits; Network theorems; Transient analysis and Two port networks.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze and solve various DC and single phase AC circuits by applying conceptual knowledge of network reduction, analyzing techniques and theorems
- CO2: Design the Components for resonant, transient circuits and Two-port networks meeting the specified needs using circuit concepts.

**DETAILED SYLLABUS:**

**UNIT-I: FUNDAMENTALS OF ELECTRICAL CIRCUITS (09 Periods)**

Basic definitions of network, circuit, node, branch and loop; network reduction techniques-series, parallel, series-parallel circuits, current division and voltage division rules; source transformation, wye-to-delta and delta-to-wye transformations; nodal analysis and super node concept, mesh analysis and super mesh concept – numerical problems with dependent and independent AC & DC sources.

**UNIT-II: ANALYSIS OF SINGLE PHASE AC CIRCUITS (09 Periods)**

Analysis of single phase AC circuits: impedance and admittance, impedance triangle; power triangle; Sinusoidal response of R, L and C elements with different combinations; current locus; Resonance, bandwidth and quality factor for series and parallel networks.

**UNIT-III: NETWORK THEOREMS (08 Periods)**

Superposition, Thevenin's, Norton's, Maximum power transfer, Millmann's and Reciprocity theorems for DC & AC Excitations (without proof).

**UNIT-IV: TRANSIENT ANALYSIS (10 Periods)**

Transient response of RL, RC and RLC for DC excitation and Sinusoidal excitation - Solution by using Differential equation and Laplace Transforms method.

**UNIT-V: TWO PORT NETWORKS (09 Periods)**

Network Functions - Driving point and transfer functions. Impedance parameters, admittance parameters, transmission (ABCD) parameters, hybrid parameters, conversion of one parameter to another, conditions for reciprocity and symmetry, interconnection of two-port networks in series, parallel and cascaded configurations.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Charles K. Alexander, Mathew N O Sadiku, *Fundamentals of Electric Circuits*, 5<sup>th</sup> edition, McGraw Hill Education (India) Private Limited, New Delhi, 2013.
2. A. Sudhakar, Shyam mohan S Palli, *Circuits and Networks Analysis and Synthesis*, 5<sup>th</sup> edition, McGraw Hill Education (India) Private Limited, New Delhi, 2015.

**REFERENCE BOOKS:**

1. J. A. Edminister, M. D. Nahvi, *Theory and Problems of Electric Circuits*, 4<sup>th</sup> edition, Schaum's outline series, McGraw Hill, New Delhi, 2004.
2. W H Hayt, J E Kemmerly, S M Durbin, *Engineering Circuit Analysis*, 6<sup>th</sup> edition, McGraw Hill, New Delhi, 2008.

**ADDITIONAL LEARNING RESOURCES**

1. <https://nptel.ac.in/courses/117106108/>
2. <https://ocw.mit.edu/high-school/physics/exam-prep/electric-circuits/>

**I B. Tech. - II Semester**  
**(19BT1BS32) ENGINEERING CHEMISTRY LAB**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Estimation of hardness, alkalinity, dissolved oxygen of water samples, Iron, Strength of an acid in Pb-acid battery and residual chlorine in drinking water by volumetric methods; Measurement of viscosity of lubricants; Instrumental methods like conductivity meter, potentiometer, P<sup>H</sup> meter and colorimeter; Characterization of simple organic compounds by UV-Vis and IR spectroscopy.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Apply analytical skills for the quantitative estimation of materials through volumetric methods of analysis and address the societal, health issues related to quality of water.

CO2: Develop analytical skills for the quantitative estimation of materials through instrumental methods of analysis.

CO3: Work independently and in teams to solve problems with effective communication.

A minimum of any **Ten** experiments are to be conducted among the following:

**List of Experiments**

1. Estimation of Hardness of water by EDTA method
2. Determination of alkalinity of Water sample
3. Estimation of Dissolved Oxygen in water by Winkler's method.
4. Estimation Fe (II) by Dichrometry
5. Conductometric titration of strong acid Vs strong base
6. Estimation of Ferrous ion by Potentiometry
7. Determination of strength of acid by P<sup>H</sup> metric method
8. Determination of Strength of an acid in Pb-Acid battery
9. Determination of Viscosity by Ostwald's viscometer
10. Determination of percentage of Iron in Cement sample by colorimetry
11. Estimation of residual chlorine in drinking water.
12. Identification of simple organic compounds by UV-Vis and IR spectroscopy

**TEXT BOOKS:**

1. K. Mukkanti, *Practical Engineering Chemistry*, BS Publications, 2013.
2. K. N. Jayaveera, K. B. Chandra Sekhar, *Chemistry laboratory manual*, S. M. Enterprises Limited, 2013.



**I B. Tech. - II Semester**  
**(19BT1HS31) COMMUNICATIVE ENGLISH LAB**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Phonetics; Vocabulary Building; Grammar; Just a Minute; Elocution/Impromptu; Giving Directions; Role Plays; Public Speaking; Describing Objects; Reading Comprehension; Listening Comprehension; Information Transfer; Letter Writing

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge of Phonetics by examining and applying sounds of English in Phonetic Transcription.
- CO2: Analyze sentence structures by applying and demonstrating the skills of Vocabulary and Grammar.
- CO3: Apply appropriate listening and reading skills by analyzing the context and demonstrate in Listening Comprehension and Reading Comprehension.
- CO4: Function effectively as an individual and as a member in diverse teams examining and applying speaking skills in Just A Minute and Role Play.
- CO5: Communicate effectively applying appropriate writing and speaking techniques by examining and demonstrating knowledge through Describing Objects, Information Transfer and Letter Writing.

**\*First Ten exercises are mandatory among the following:**

**List of Exercises:**

**1. Just a Minute, Elocution/Impromptu**

*Steps to be followed – Useful tips – Dos & Don'ts – Preparation – Examples*

**2. Phonetics**

*Sounds of English – Consonants – Vowels – Speech Organs – Phonetic Transcription – Word Accent – Basics of Intonation*

**3. Vocabulary Building**

*Prefixes & Suffixes – Synonyms & Antonyms – Phrasal verbs – Idioms – One word substitutes – Words often confused*

**4. Grammar**

*Tenses – Nouns – Word order and error correction*

**5. Giving Directions**

*Useful phrases – Sample conversations – Exercises*

**6. Role Plays**

*Useful tips – Dos & Don'ts – Exercises – Role Plays for practice*

**7. Public Speaking**

*Stage presence – Voice control – Body Language – Rehearsals – Audience – Delivery – Dos & Don'ts – Project Submission*

## **8. Letter Writing**

*Introduction – Objective – Formats – Types – Exercises*

## **9. Describing Objects**

*Jargon – Useful Phrases – Do's & Don'ts – Exercises*

## **10. Listening Comprehension**

*Introduction – Types of listening – Practice – Benefits of listening – Exercises*

## **11. Information Transfer**

*Tables – Pie Charts – Venn Diagrams – Graphs – Flow Charts – Steps to be followed – Exercises*

## **12. Reading Comprehension**

*Introduction – Types of reading – Inferring – Critical analysis – Exercises*

### **TEXT BOOK:**

#### **1. Communicative English Lab Manual (SVEC-19)**

### **REFERENCE BOOKS:**

1. D. Sudha Rani, *A Manual for English Language Laboratories*, Pearson, Noida, 2010.
2. Nira Kumar, *English Language Laboratories*, PHI Learning Pvt. Ltd., New Delhi, 2011.

### **SUGGESTED SOFTWARE:**

1. SoftX
2. Speech Solutions
3. English Pronunciation Dictionary by Daniel Jones
4. Learning to Speak English 8.1, The Learning Company – 4 CDs.
5. Mastering English: Grammar, Punctuation and Composition.
6. English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
7. Dorling Kindersley Series of Grammar.
8. Language in Use 1, 2 & 3
9. Cambridge Advanced Learner's Dictionary - 3rd Edition
10. Centronix – Phonetics
11. Let's Talk English, Regional Institute of English South India.

### **ADDITIONAL LEARNING RESOURCES**

1. <https://goo.gl/IjE45p>: Amazon India site – with thousands of different product descriptions
2. <https://goo.gl/3ozeO6>: 15 ways to calm your nerves before giving a presentation.
3. <https://goo.gl/p20ttk>: useful site for more language about introducing yourself.

**I B. Tech. – II Semester**  
**(19BT10331) COMPUTER AIDED ENGINEERING DRAWING**  
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	1	2	2

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Engineering drawing conventions; Importance of engineering drawing; fundamental concepts of sketching; computer aided drafting and different types of projections of geometric entities (both 2D and 3D) through computer aided drafting packages.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Apply the principles of engineering drawing, Methods and CAD tools to draw the Geometries, Curves and Orthographic projections used to communicate in engineering applications.

CO2: Develop lateral surfaces of solids and draw Isometric views of given objects for engineering communication using principles of engineering drawing and CAD tools.

CO3: Work independently / in groups & communicate effectively in oral and written forms.

**DETAILED SYLLABUS:**

**Introduction to Engineering Graphics and Design:**

Principles, significance -Conventions in drawing-lettering - BIS conventions-Dimensioning principles and conventional representations.

**Exercises:**

1. Practice exercise on Basic Lettering and Dimensioning
2. Practice exercise on Conventional representations

**Introduction to AutoCAD:** Basic drawing and editing commands: line, circle, rectangle, erase, view, undo, redo, snap, object editing, moving, copying, rotating, scaling, mirroring, layers, templates, polylines, trimming, extending, stretching, fillets, arrays, dimensions.

**Exercises:**

3. Practice exercise using basic drawing commands
4. Practice exercise using editing commands

**CONICS, CURVES, PROJECTION OF POINTS, LINES AND PLANES**

**Conics & Special Curves:** Conic sections including the rectangular hyperbola-eccentricity method only; Cycloid, Epicycloid and Hypocycloid, Involutess.

**Exercises:**

5. Practice exercises on Ellipse, Parabola, Hyperbola and Rectangular Hyperbola
6. Practice exercises on Cycloid, Epicycloid, Hypocycloid and Involutess

**Projection of points, lines and planes:** Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line , Projections of regular plane surfaces.

**Exercises:**

7. Practice exercises on Projection of points
8. Practice exercises on projection of lines inclined to one plane
9. Practice exercises on projection of lines inclined to both planes
10. Practice exercises on Projections of regular plane surfaces

**PROJECTION OF SOLIDS AND SECTION OF SOLIDS**

**Projection of solids:** Projection of regular solids inclined to one plane.

**Sections of solids:** Section planes and sectional view of right regular solids- prism, cylinder, pyramid and cone, True shapes of the sections.

**Exercises:**

11. Practice exercises on Projections of regular solids
12. Practice exercises on Sections of solids

**DEVELOPMENT OF SURFACES**

**Development of surfaces:** Development of surfaces of right regular solids-prism, cylinder, pyramid, cone and their sectional parts.

**Exercises:**

13. Practice exercises on Development of surfaces of right regular solids

**ORTHOGRAPHIC AND ISOMETRIC PROJECTIONS**

**Orthographic Projections:** Systems of projections, conventions and application to orthographic projections.

**Isometric Projections:** Principles of isometric projection- Isometric scale; Isometric views: lines, planes, simple solids.

**Exercises:**

14. Practice exercises on Orthographic Projections
15. Practice exercises on Isometric Projections

**TEXT BOOKS:**

1. D. M. Kulkarni, A. P. Rastogi, A. K. Sarkar, *Engineering Graphics with AutoCAD*, PHI Learning Private Limited, New Delhi, Revised Edition, 2010.
2. N D Bhatt and V M Panchal, *Engineering Drawing*, Charotar Publishing House, Gujarat, 51<sup>st</sup> edition, 2013.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Sham Tickoo, *AutoCAD 2013 for Engineers and Designers*, Dreamtech Press, 2013.
2. M. H. Annaiah & RajashekarPatil, *Computer Aided Engineering Drawing*, New Age International Publishers, 4<sup>th</sup> edition, 2012.

**I B. Tech. – II Semester**  
**(19BT10531) PROGRAMMING FOR PROBLEM SOLVING LAB**  
 (Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

**PRE-REQUISITES:** A course on Basic Mathematics

**COURSE DESCRIPTION:** The course is designed to provide hands on practice on Scratch programming and python programming for problem solving.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Develop scripts using Scratch tool to simulate simple problems.
- CO2: Apply Python Constructs and Modules to develop solutions for real-life problems.
- CO3: Function effectively as an individual and in team to foster knowledge and creativity.
- CO4: Write and present a substantial technical report/ document effectively.

**PRACTICAL EXERCISES:**

- 1)
  - a) Design a script in Scratch to simulate Airplane for take-off and land.
  - b) Design a script in Scratch to make a sprite to ask the user to enter two different numbers and an arithmetic operator and then calculate and display the result.
- 2)
  - a) Design a script in Scratch to calculate factorial of a given number.
  - b) Design a script in Scratch to simulate Maze game. (Hint: To get Maze images refer <http://inventwithScratch.com/downloads/>)
- 3)
  - a) Write a python script to read two integer numbers and perform arithmetic operations.
  - b) Write a python script to evaluate following expressions by considering necessary inputs.  
 i)  $ax^2 + bx + c$    ii)  $ax^5 + bx^3 + c$    iii)  $(ax + b) / (ax - b)$    iv)  $x - a / b + c$
- 4)
  - a) Write a python script to convert given decimal number into octal, hexa decimal and binary.
  - b) Write a python script to read four integer values separated with commas and display the sum of those four numbers.
  - c) Write a python script to print "SVEC" with prefix of ten spaces by using format().
- 5)
  - a) Write a python script to calculate electricity bill based on following slab rates.

<u>Consumption units</u>	<u>Rate (in Rupees/Unit)</u>
0-100	4
101-150	4.6
151-200	5.2
201-300	6.3
Above 300	8

(Hint: To get Consumption units take current Meter reading, old meter reading from the user as input)

- b) Print the following pattern using python script.

```

          1
        1 2 1
      1 2 3 2 1
    1 2 3 4 3 2 1
  1 2 3 4 5 4 3 2 1

```

- 6) a) Write a python script to read  $N$  student details like name, roll number, branch and age. Sort the student details based on their names and display.  
 b) Write a python script to delete duplicate strings from a list of strings. (Insertion order should maintain after deleting duplicate string).  
 c) Write a python script to read  $N$  number of student details into nested list and convert that as a nested dictionary.
- 7) a) Design a function that can perform sum of two or three or four numbers.  
 b) Write a python script to implement towers of Hanoi problem.  
 c) Write a Python function prime square ( $l$ ) that takes a nonempty list of integers and returns True if the elements of  $l$  alternate between perfect squares and prime numbers, and returns False otherwise. Note that the alternating sequence of squares and primes may begin with a square or with a prime. Here are some examples to show how your function should work.
- ```

>>>primesquare([4])
True
>>>primesquare([4,5,16,101,64])
True
>>>primesquare([5,16,101,36,27])
False

```
- 8) a) Write a python script to perform arithmetic operations on numpyarrays.  
 b) Write a python script to perform following matrix operations using numpy.  
 i) Dot product      ii) Matrix product      iii) Determinant      iv) Inverse
- 9) a) Write a python script to Create Pandas data frame using list of lists.  
 b) Write a python script to load data from a CSV file into a Pandas Data Frame and perform basic operations on it.
- 10) a) Draw a Scatter Plot by considering an appropriate data set.  
 b) Draw histograms by considering an appropriate data set.
- 11)      **Mini Project-1**
- 12)      **Mini Project-2**

#### TEXT BOOK:

1. R. Nageswara Rao, *Core Python Programming*, 2<sup>nd</sup> edition, Dreamtech Press, 2018.

**I B. Tech. - II Semester**  
**(19BT20251) NETWORK ANALYSIS LAB**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** Physics at Intermediate Level.

**COURSE DESCRIPTION:** Practical investigations on DC, single phase AC circuits, circuit theorems, transient circuits and Two-Port networks.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze, measure, interpret and validate the practical observations by applying the conceptual knowledge of electrical networks.
- CO2: Design resonant, transient and Two-port circuits/networks meeting the specified needs using electrical circuits/networks concepts.
- CO3: Work independently and in teams to solve problems with effective communication.

**List of Experiments:**

Minimum Ten experiments are to be conducted.

1. Analysis of Series and Parallel circuits.
2. Mesh and Nodal analysis.
3. Phasor analysis of RL, RC and RLC circuits.
4. Current locus of RL and RC circuits.
5. Series and Parallel resonance.
6. Measurement of active and reactive power in a single phase circuit.
7. Verification of Superposition and Reciprocity theorems.
8. Verification of Thevenin's and Norton's theorem.
9. Verification of Maximum Power transfer theorem for DC and AC excitations.
10. Transient response of RL, RC and RLC circuits.
11. Determination of Open circuit and Short circuit parameters in isolated and interconnected networks.
12. Determination of ABCD and Hybrid parameters in isolated and interconnected networks.

**REFERENCE BOOKS / LAB MANUALS:**

1. P. S. Dhogal, *Basic Practicals in Electrical Engineering*, Standard Publishers, 2004.
2. Yannis Tsividis, *A First Lab in Circuits and Electronics*, Wiley, 1<sup>st</sup> edition, 2001.

**ADDITIONAL LEARNING RESOURCES:**

1. [www.vlab.co.in](http://www.vlab.co.in), *Virtual Electric Circuits Lab*, A initiative of MHRD under NMEICT.
2. <https://nptel.ac.in/courses/117106108/>
3. <https://ocw.mit.edu/high-school/physics/exam-prep/electric-circuits/>

**II B. Tech. - I Semester**  
**(19BT3BS02) SPECIAL FUNCTIONS AND COMPLEX ANALYSIS**  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | 1 | - | 4 |

**PRE-REQUISITES:** A course on Differential equations and Multivariable calculus

**COURSE DESCRIPTION:** Special Functions (Beta and Gamma functions); Special Functions (Bessel's and Legendre's equations); Analytic Functions; Conformal Mapping; Complex Integration; Residue Theorem.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Apply the knowledge of special functions to evaluate improper integrals.

CO2: Analyze the behavior of functions through the knowledge of complex analysis and evaluate integrals on complex planes.

**DETAILED SYLLABUS:**

**UNIT-I: SPECIAL FUNCTIONS (Beta and Gamma Functions) (07 Periods)**

Beta and Gamma functions: Properties, Relationship between beta and gamma functions, Evaluation of integrals using beta and gamma functions.

**UNIT-II: SPECIAL FUNCTIONS (Bessel's and Legendre's Equations) (09 Periods)**

Bessel's equation: Recurrence formulae for  $J_n(x)$ , Generating function for  $J_n(x)$  (without proof), Orthogonality of Bessel functions; Legendre's equation: Legendre polynomials, Rodrigue's formula, Generating function for  $P_n(x)$  (without proof), Recurrence formulae for  $P_n(x)$ .

**UNIT-III: ANALYTIC FUNCTIONS AND CONFORMAL MAPPING (11 Periods)**

Differentiation, analytic functions, Cauchy-Riemann equations (both Cartesian and polar), harmonic functions, harmonic conjugate, potential functions; Conformal mapping: Definition and examples, Translation, Rotation, Inversion, Transformations  $w = z^2, e^z$ ; Bilinear transformation and their properties.

**UNIT-IV: COMPLEX INTEGRATION (08 Periods)**

Line integrals, Cauchy's theorem (without proof), Cauchy's integral formula (without proof), Generalized Cauchy's integral formula (without proof); Taylor's series, Laurent's series; zeros of an analytic functions, Singularities: Types of singularities, pole of order n.



**UNIT-V: RESIDUE THEOREM****(10 Periods)**

Residues and evaluation of residues at poles, Cauchy's Residue theorem (without proof), evaluation of integrals using residue theorem, evaluation of improper and real integrals

of the type: (i)  $\int_0^{2\pi} f(\cos \theta, \sin \theta) d\theta$  ii)  $\int_{-\infty}^{\infty} f(x) dx$  iii)  $\int_{-\infty}^{\infty} e^{imx} f(x) dx$ .

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. T. K. V. Iyengar, B. Krishna Gandhi, S. Ranganatham and M. V. S. S. N. Prasad, *Text book of Engineering Mathematics, Vol-III*, S. Chand & Company, 9<sup>th</sup> edition, 2012.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44<sup>th</sup> edition, 2017.

**REFERENCE BOOKS:**

1. J. W. Brown and R. V. Churchill, *Complex Variables and Applications*, Mc-Graw Hill, 7<sup>th</sup> edition, 2004.
2. N. P. Bali and Manish Goyal, *A text book of Engineering Mathematics*, Laxmi Publications, Reprint, 2010.

## II B. Tech. - I Semester

### (19BT30401) ELECTROMAGNETIC FIELDS AND TRANSMISSION LINES

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | 1 | - | 4 |

**PRE-REQUISITES:** Courses on Transformation Techniques and Linear Algebra & Engineering Physics

**COURSE DESCRIPTION:** Static Fields; Maxwell's Equations; Electromagnetic Wave Propagation; Transmission Lines.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze time invariant electromagnetic field equations in different media.
- CO2: Solve problems on time variant electromagnetic fields using Maxwell's Equations
- CO3: Understand the Reflection and refraction of Uniform Plane Waves for Electromagnetic Wave Propagation in various media.
- CO4: Design impedance transformers by applying impedance matching techniques for maximum power transfer in transmission Lines.

#### **DETAILED SYLLABUS:**

*Review of calculus and vector algebra*

#### **UNIT-I: STATIC FIELDS**

**(10 Periods)**

##### **Static Electric Field**

Coulomb's Law, Electric Field Intensity – Fields due to Different Charge Distributions. Electric Flux Density, Gauss Law and Applications, Electric Potential, Relations between E and V, Convection and Conduction Currents, Continuity Equation. Capacitance – Parallel Plate, Coaxial Capacitors.

##### **Static Magnetic Field**

Biot-Savart's Law, Ampere's Circuital Law, Magnetic Flux Density. Magnetic Scalar and Vector Potentials, Forces due to Magnetic Fields, Ampere's Force Law, illustrative Problems.

#### **UNIT-II: MAXWELL'S EQUATIONS AND BOUNDARY CONDITIONS (09 Periods)**

##### **Maxwell's Equations**

Faraday's Law and Transformer emf, Inconsistency of Ampere's Law and Displacement Current Density, Maxwell's Equations in Different Final Forms and Word Statements (time variant and invariant).

##### **Boundary Conditions**

Conditions at a Boundary Surface: Dielectric-Dielectric and Dielectric-Conductor Interfaces, illustrative Problems.

**UNIT-III: ELECTROMAGNETIC WAVE PROPAGATION****(10 Periods)**

Wave Equations for Conducting and Perfect Dielectric Media, Uniform Plane Waves – Definition, Sinusoidal Variations, Wave Propagation in Lossless and Conducting Media. Conductors & Dielectrics – Characterization, Wave Propagation in Good Conductors and Good Dielectrics. Polarization

Reflection – Normal Incidences and Oblique Incidences for both Perfect Conductor and Perfect Dielectrics. Refraction of Plane Waves - Brewster Angle, Total Internal Reflection.

Poynting Vector and Poynting Theorem, Illustrative Problems.

**UNIT-IV: TRANSMISSION LINES - I****(08 Periods)**

Types, Parameters, Transmission Line Equations, Primary & Secondary Constants, Expressions for Characteristic Impedance, Propagation Constant, Phase and Group Velocities, Infinite Line Concepts, Lossless/Low Loss Characterization, Condition for Distortionless Lines.

**UNIT-V: TRANSMISSION LINES - II****(08 Periods)**

Input Impedance Relations, SC and OC Lines, Reflection Coefficient, VSWR.  $\lambda/4$ ,  $\lambda/2$ ,  $\lambda/8$  Lines – Impedance Transformations. Smith Chart – Configuration and Applications, Single stub matching, Illustrative Problems.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Mathew O Sadiku, "*Principles of Electromagnetics*", Oxford University press, 6<sup>th</sup> Edition, New York, 2011.
2. John D. Ryder, *Networks, Lines and Fields*, PHI, 2<sup>nd</sup> Edition, 1999.

**REFERENCE BOOKS:**

1. William Hayt and John Buck "*Engineering Electromagnetics*", Tata McGraw Hill, 7<sup>th</sup> Edition, New Delhi, 2012.
2. E.C. Jordan and K.G. Balmain, *Electromagnetic Waves and Radiating Systems*, PHI, 2<sup>nd</sup> Edition, 2000.

**ADDITIONAL LEARNING RESOURCES:**

1. [https://swayam.gov.in/nd1\\_noc20\\_ph08](https://swayam.gov.in/nd1_noc20_ph08)

**II B. Tech. – I Semester**  
**(19BT30402) ELECTRONIC DEVICES AND CIRCUITS**  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Basic Electrical and Electronics Engineering, Differential Equations and Multivariable Calculus & Engineering Physics.

**COURSE DESCRIPTION:** Linear and Non-Linear Wave shaping, Biasing and small signal analysis of BJT & FET, Operation and characteristics of Special Purpose electronic devices.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the response of High pass circuits, Low pass RC circuits for various signals and performance of clippers and clampers.
- CO2: Design transistor biasing circuits and stabilize the operating point using appropriate techniques.
- CO3: Develop mathematical model of BJT for CE, CB and CC configurations using h-parameters.
- CO4: Analyze various configurations and biasing techniques for FET.
- CO5: Demonstrate the operation and characteristics of special purpose semiconductor devices for real time applications.

**DETAILED SYLLABUS:**

**UNIT-I: LINEAR & NONLINEAR WAVE SHAPING (09 Periods)**

High-pass, Low-pass RC circuits, their response for Sinusoidal, Step, Pulse, Square and Ramp inputs. High pass RC network as a Differentiator, Low pass RC network as an Integrator, Diode clippers and Clampers.

**UNIT-II: TRANSISTOR BIASING & STABILISATION (10 Periods)**

DC Load Line analysis and Selection of Q point, Biasing Circuits-Fixed(Base) Bias, Collector-to-Base Bias, Base Bias and collector-to-Base Bias with Emitter Resistor, Voltage Divider Bias Circuit, Thermal stability of Bias circuits, compensation techniques using Thermistor, Sensistor and Diode.

**UNIT-III: SMALL SIGNAL ANALYSIS OF BJT (09 Periods)**

Transistor modeling using h-Parameters, CE, CB and CC circuit analysis using h-parameters, Simplified hybrid model, Comparison of CB, CE and CC circuits, Analysis of CE amplifier with emitter resistance.

**UNIT-IV: FIELD EFFECT TRANSISTOR****(10 Periods)**

Construction, Operation and characteristics of JFET, Enhancement MOSFET & Depletion MOSFET, FET Biasing-Gate bias, Self bias, voltage divider bias, FET equivalent circuit, CS,CD and CG amplifiers, comparison of BJT & FET.

**UNIT-V: SPECIAL PURPOSE ELECTRONIC DEVICES****(07 Periods)**

Tunnel Diode, Varactor Diode, Unijunction Transistor (UJT),UJT as Relaxation Oscillator, DIAC, TRIAC, Silicon Controlled Rectifier

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Jacob Millman, Herbert Taub and Surya prakash Rao Mothiki, *Pulse Digital and Switching Waveforms*, TMH, 3<sup>rd</sup> edition,2011.
2. J. Millman, Christos C. Halkias and SatyabrataJit, *Electronic Devices and Circuits*, TMH, 3<sup>rd</sup> Edition, 2010.

**REFERENCE BOOKS:**

1. David A. Bell, *Electronic Devices and Circuits*, Oxford University press, 5<sup>th</sup> Edition, 2014
2. S. Salivahanan, N. Suresh Kumar, *Electronic Devices and Circuits*, TMH, 3<sup>rd</sup> Edition 2013.
3. R.L. Boylestad and Louis Nashelky, *Electronic Devices and Circuits*, PHI, 10<sup>th</sup> Edition, 2009.

**ADDITIONAL LEARNING RESOURCES:**

1. <http://www.nptelvideos.in/2012/11/basic-electronics-prof-tsnatarajan.html>
2. [https://kupdf.net/download/n-n-bhargava-basic-electronics-and-linear-circuits\\_5912b54adc0d60a324959ea5\\_pdf](https://kupdf.net/download/n-n-bhargava-basic-electronics-and-linear-circuits_5912b54adc0d60a324959ea5_pdf)
3. <http://www.talkingelectronics.com/Download%20eBooks/Principles%20of%20electronics/CH-21.pdf>

**II B. Tech. – I Semester**  
**(19BT30403) SIGNALS AND SYSTEMS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Differential Equations and Multivariable Calculus & Transformation Techniques and Linear Algebra.

**COURSE DESCRIPTION:** Analysis of signals and systems; Representation of signals using Fourier series and Fourier transforms; Time-Domain and Frequency-Domain aspects of signals and systems; concept of convolution and correlation; Sampling and types of sampling; Laplace transform of signals.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the basic operations on signals & sequences and determine the response of LTI systems using convolution.
- CO2: Apply fourier series and transform to analyse spectral characteristics of continuous-time periodic and aperiodic signals.
- CO3: Analyse the properties of correlation and convolution to extract signals from noisy signal in various applications.
- CO4: Apply Laplace transformation technique to analyse the characteristics of LTI systems.
- CO5: Analyse sampling & its effects and reconstruct signals using interpolation.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO SIGNALS AND SYSTEMS (12 Periods)**

Elementary signals- Unit Impulse and Unit Step Functions, Exponential and Sinusoidal Signals. Classification of Continuous- Time and Discrete-Time Signals, Basic operations on signals, Classification of Continuous-Time and Discrete-Time Systems, Basic System Properties, Linear Time-Invariant Systems -Discrete-Time LTI Systems- The Convolution Sum, Continuous-Time LTI Systems –Convolution Integral, Properties of Linear Time-Invariant Systems.

**UNIT-II: FOURIER SERIES AND FOURIER TRANSFORM (12 Periods)**

Fourier series: Representation of Fourier series, Continuous time periodic signals, Dirichlet's conditions, Properties of CT Fourier Series, Trigonometric Fourier Series and Exponential Fourier Series with examples. Complex Fourier spectrum. Fourier series representation of a periodic signals. Fourier Transforms: Deriving Fourier Transform from Fourier series, Fourier Transform of standard signals, Fourier Transform of Periodic Signals, Properties of CT Fourier Transform, Systems characterized by Linear constant coefficient differential equations. The Magnitude-Phase Representation of the Fourier Transform, The Magnitude-Phase Representation of the Frequency Response of LTI Systems.

**UNIT-III: CORRELATION OF SIGNALS****(07 Periods)**

Cross correlation and auto correlation of functions, properties of correlation function, Energy density spectrum, Parseval's theorem, Power density spectrum, Relation between auto correlation function and energy/power spectral density function. Relation between convolution and correlation, Detection of periodic signals in the presence of noise by correlation in radar systems, Extraction of signal from noise by filtering.

**UNIT-IV: LAPLACE TRANSFORMS****(07 Periods)**

The Laplace Transform, The Region of Convergence for Laplace Transforms, The Inverse Laplace Transform, Relationship between Fourier and Laplace Transforms, Properties of the Laplace Transform, Some Laplace Transform Pairs, Analysis and Characterization of LTI Systems Using the Laplace Transform.

**UNIT-V: SAMPLING****(07 Periods)**

Representation of a Continuous-Time Signal by its Samples - Sampling Theorem, Reconstruction of a Signal from Its Samples Using Interpolation. Effect of under sampling - Aliasing, Discrete-Time Processing of Continuous-Time Signals.

**Total periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOK:**

1. Alan V. Oppenheim, Alan S. Willsky, & S. Hamid, *Signals and Systems*, Pearson Higher Education, 2nd Edition, 2008.

**REFERENCE BOOKS:**

1. Simon Haykin and B. Van Veen, *Signals & Systems*, John Wiley, 2nd Edition, 2010.
2. A. Anand Kumar, *Signals & Systems*, PHI, 2011

**ADDITIONAL LEARNING RESOURCES**

1. Hilbert Transform: <https://ieeexplore.ieee.org/document/5609110>
2. Impulse Response Application: <https://ieeexplore.ieee.org/document/629264>
3. SAMPLING: [https://www.researchgate.net/publication/325846982\\_SAMPLE\\_AND\\_SAMPLING\\_DESIGNS](https://www.researchgate.net/publication/325846982_SAMPLE_AND_SAMPLING_DESIGNS)

**II B. Tech. – I Semester**  
**(19BT30404) SWITCHING THEORY AND LOGIC DESIGN**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Number system and Boolean algebra; Minimization; Analysis and synthesis of digital circuits; Asynchronous Sequential Logic & Programmable Memories.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate the knowledge of Boolean Algebra, various number systems and Logic gates to implement Digital Circuits.
- CO2: Design subsystem by Analyzing combinational & sequential logic circuits for providing optimal solutions
- CO3: Develop Asynchronous sequential logic and programmable memories for societal needs.
- CO4: Design various programmable logic arrays using logic gates

**DETAILED SYLLABUS:**

**UNIT-I: NUMBER SYSTEMS AND BOOLEAN ALGEBRA (10 Periods)**

Digital systems, Binary Numbers, Number base conversions, Complements of numbers, Signed binary numbers, Binary codes, Error detection and correction codes. Boolean Algebra-Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, logic operations & Logic gates.

**UNIT-II: GATE LEVEL MINIMIZATION (08 Periods)**

The map method, four variable, Five variable K-map, POS & SOP Simplification, Don't care conditions, NAND & NOR Implementation, Other two level Implementation, Ex-or Function, Tabular Method- Simplification of Boolean function using tabulation Method.

**UNIT-III: COMBINATIONAL LOGIC DESIGN (09 Periods)**

Combinational circuits, Analysis & Design procedure, Binary Adder-Sub tractor, Decimal Adder, Binary Multiplier, Magnitude comparator, Decoder, Encoders, Multiplexers and De- Multiplexers.

**UNIT-IV: SEQUENTIAL LOGIC DESIGN (11 Periods)**

Sequential Circuits, Latches, Flip-Flops, Analysis of Clocked sequential circuits, State Reduction & Assignment, Design procedure, Introduction to Registers-Universal Shift Registers, Introduction to Counters, Ripple Counters-Binary and BCD Ripple Counter , Synchronous counters-Binary, Up-Down Binary Counter and BCD Counter and Other counters-Ring Counter, Johnson Counter.

**UNIT-V: ASYNCHRONOUS SEQUENTIAL LOGIC AND PROGRAMMABLE MEMORIES (07 Periods)**

Introduction, Analysis procedure, Design Procedure-Primitive Flow Table, Reduction of State and Flow Tables-Implication Table and Implied States, Hazards, ROM, PLA, PAL.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**



**TEXT BOOK:**

1. M. Morris Mano, Michael D. Ciletti, *Digital Design With an Introduction to the Verilog HDL*, Pearson, 5<sup>th</sup> edition, 2017.

**REFERENCE BOOKS:**

1. A. Anand Kumar, *Switching Theory and Logic Design*, PHI Learning Private Limited, 3<sup>rd</sup> edition, India, 2017.
2. Charles H. Roth, Jr. and Larry L. Kinney, *Fundamentals of Logic Design*, Cengage Learning, 7<sup>th</sup> edition, 2015

**II B. Tech. – I Semester**  
**(19BT3HS31) SOFT SKILLS LAB**  
(Common to CE, ME, EEE, ECE and EIE))

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Body Language; Assertiveness; Goal Setting; Thinking Skills; Team Building; Conflict Management; Technical Report Writing; Résumé Writing; Group Discussions; Interview Skills; Interpersonal Skills; Etiquette.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge of career skills by examining and applying the styles and strategies of Goal Setting, Thinking Skills, and Etiquettes.
- CO2: Analyze the limitations and possibilities of favourable situations by applying the skills of Body Language and demonstrate through Assertiveness, and Interpersonal Skills.
- CO3: Apply appropriate soft skills by analyzing the problem situations that arise in professional career through demonstrating remedies in Conflict Management.
- CO4: Demonstrate ability to function effectively as an individual and as a member in diverse teams examining and applying soft skills in Interviews, Group Discussion and Team Building.
- CO5: Apply appropriate speaking and writing techniques in preparing documents and to communicate effectively by examining and demonstrating knowledge in Technical Report Writing and Résumé Writing.

**\*First TEN exercises are mandatory among the following:**

**List of Exercises:**

**1. Body Language**

*Types of Body Language – Parts of Body – Facial Expressions – Eye Contact Insights – Good Posture*

**2. Assertiveness**

*Communications Styles – Benefits – Being Unassertive – Role Playing*

**3. Goal Setting**

*Seven Steps of Goal Setting – Self Motivation – Personal Goal Setting – Setting Career Goals*

**4. Thinking Skills**

*Positive Thinking – Creative Thinking – Lateral Thinking – Logical Thinking – Intuitive Thinking*

**5. Team Building**

*Learning Activities – Management Essentials – Team Building Scenarios*

**6. Conflict Management**

*Ways of Resolving Conflict – Personality Types and Conflict – Conflict Resolution Process – Team Conflict*

## **7. Technical Report Writing**

*Objectives – Formats – Writing Styles*

## **8. Résumé Writing**

*Structure and Presentation – Planning – Defining Career Objectives – Projecting One's Strengths and Skills – Cover Letter – Formats and Styles*

## **9. Group Discussions**

*Types of GD – Dos and Don'ts – Dynamics of GD – Intervention – Summarization Techniques*

## **10. Interview Skills**

*Planning – Opening Strategies – Answering Strategies – Tele Conferencing – Video Conferencing*

## **11. Interpersonal Skills**

*Starting a Conversation – Responding to a Conversation – Conversation Examples – Body Language – Role Play*

## **12. Etiquette**

*Basic Social Etiquette – Telephone Etiquette – Dining Etiquette – Conference Etiquette*

### **TEXT BOOK:**

1. Soft Skills Lab Manual, SVEC.

### **REFERENCE BOOKS:**

1. R. C. Sharma & Krishna Mohan, *Business Correspondence and Report Writing*, Tata McGraw-Hill Publishing Company Limited, 3<sup>rd</sup> edition, New Delhi, 2012.

### **SUGGESTED SOFTWARES:**

1. KVAN SOLUTIONS
2. Learning to Speak English 8.1, The Learning Company – 4 CDs.
3. English in Mind, Herbert Puchta and Jeff Stranks with Meredith Levy, Cambridge.
4. Language in Use 1, 2 & 3.
5. Cambridge Advanced Learner's Dictionary - 3rd Edition.
6. Let's Talk English, Regional Institute of English South India.

### **ADDITIONAL LEARNING RESOURCES**

1. <http://www.career.vt.edu/interviewing/TelephoneInterviews.html>
2. [http://job-search-search.com/interviewing/behavioral\\_interviews](http://job-search-search.com/interviewing/behavioral_interviews)
3. <https://goo.gl/laEHOY> (dealing with complaints)
4. <http://www.adm.uwaterloo.ca/infocecs/CRC/manual/resumes.html>
5. <https://goo.gl/FEMGXS>

## II B. Tech. - I Semester

### (19BT30431) ELECTROMAGNETIC FIELDS AND TRANSMISSION LINES LAB

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PREREQUISITES:** Courses on Transformation Techniques and Linear Algebra & Engineering Physics

**COURSE DESCRIPTION:** Design and Simulation of electric and magnetic fields (Time variant and Time-invariant) due to Charged particles, finite lines. Simulation of Maxwell's equation and wave equation, primary and secondary constants of Transmission lines.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the vector field, vector product, Coulomb law, Electric flux lines, Electric Potential and Bio-Savart's Law.
- CO2: Solve Uniform Plane Wave equation for Electromagnetic Wave Propagation.
- CO3: Design and verify the conditions for lossless and distortionless transmission lines.
- CO4: Analyze the time-variant and time-invariant electromagnetic fields in different media.
- CO5: Work independently and in teams to solve problems with effective Communication.

#### List of Exercises/List of Experiments:

(Minimum **Ten** experiments are to be conducted)

Simulate the following analytically using MATLAB

1. Plot the following three different graphs in MATLAB
  - a) Plot a Circle
  - b) Quiver plot or Electric line in 2D
  - c) Quiver plot or Electric line in 3D
2.
  - a) Find the Slope of the differential equation given below:  
  
  - b) Plot the Vector field and Volume Visualization.
  - c) For the given two vectors, find the Dot product, the projection and the angle between the vectors.
3. Plot fields due to discrete charge distributions using Coulomb Law.
4. Plot the Electric Flux lines in 3D due to a point charge located at the origin.
5. Calculate and plot Potential and Electric Field in 2D due to two charges of different magnitudes and same sign that are placed along x-axis.
6. Plot and visualize Variable EM Fields and Potentials.
7. Calculate the electric energy stored due to the electric field in cylindrical coordinates.
8. Find the energy stored in a Parallel-Plate Capacitor.

9. Verify Bio-Savart's Law and plot magnetic field due to a current carrying finite wire.
10. Determine and Verify Electric field across dielectric-dielectric media.
11. Plot  $\nabla \times \mathbf{E} = -\partial \mathbf{B} / \partial t$  in full 3D, using the proper term for the electric and magnetic counterparts and visualize Maxwell's equations using MATLAB.
12. Plot E-Field and H-Field.
13. For the given Primary Constants.
  - a) Find the secondary Constants  $Z_0$ ,  $\alpha$ ,  $\beta$ ,  $\gamma$ ,  $\omega$  and Velocity of propagation
  - b) Find the Propagation Constant for Lossless Transmission Line
  - c) Verify the Condition for Distortion less Transmission line.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Lonngren Savov, "*Fundamentals of Electromagnetics with MATLAB*", Sitech Publications, 2007.
2. Matthew N. O. Sadiku, Ph.D, "*Numerical Techniques in Electromagnetics*", third edition, CRC Press, New York, Washington, 2009.

**SOFTWARE/Tools used:** MATLAB

**II B. Tech. - I Semester**  
**(19BT30432) ELECTRONIC DEVICES AND CIRCUITS LAB**  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A Course on Basic Electrical and Electronics Engineering.

**COURSE DESCRIPTION:** Integrator and Differentiator, Clippers and Clampers, Transistor switch, h-parameter calculation, Drain and Transfer characteristics of FET, Frequency response of CE and CS amplifiers, UJT Relaxation oscillator, Characteristics of DIAC and SCR

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the response of RC circuits for square input.
- CO2: Analyze the characteristics of BJT, FET, DIAC and SCR.
- CO3: Design BJT and FET Amplifiers and evaluate the performance parameters from the frequency response.
- CO4: Develop the basic applications of diode, transistor and UJT for desired specifications.
- CO5: Work independently and in teams to solve problems with effective Communication.

**List of Exercises/List of Experiments:**

(Minimum **Ten** Experiments are to be conducted)

1. Design RC integrator and differentiator and determine their response to the square input.
2. Develop clipper circuit to clip positive and negative portions of the input waveform with two reference voltages.
3. Develop clamping circuits to clamp different positive and negative dc levels of the input signal.
4. Verify the switching action of a BJT with suitable circuit.
5. Verify input and output characteristics of BJT in Common Base configuration experimentally and find required h – parameters from the graphs
6. Verify the frequency response of Common Emitter Amplifier.
7. Study and draw the Drain and Transfer Characteristics of a JFET experimentally.
8. Verify the Frequency Response of Common Source Amplifier using JFET.
9. Study and draw the V-I Characteristics of DIAC experimentally.
10. Study and draw the V-I Characteristics of SCR experimentally.
11. Design a Relaxation Oscillator using UJT.
12. Design and analyze any biasing circuit using BJT.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Navas K.A, *Electronics Lab Manual (Volume 2)*, PHI Learning Private Ltd. 6<sup>th</sup> Edition, 2018.

**SOFTWARE/Tools used: -****ADDITIONAL LEARNING RESOURCES:**

1. [www.vlab.co.in](http://www.vlab.co.in), Basic Electronics Lab, An initiative of MHRD under NMEICT.

**II B. Tech. – I Semester**  
**(19BT30433) SIGNALS AND SYSTEMS LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Generation of various signals and sequences; convolution and correlation; verification of linearity and time invariance properties; sampling theorem verification; Transform Techniques and Transfer function of system.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyse the properties of systems by performing basic operations on various signals and sequences generated using MATLAB tool.
- CO2: Apply Fourier and Laplace transformation techniques on signals and systems to analyze spectrum and pole zero plots.
- CO3: Develop systems to separate and remove the noise components from the noisy signals.
- CO4: Work independently and in teams to solve problems with effective Communication.

**List of Exercises/List of Experiments:**

(Minimum **Ten** experiments are to be conducted)

1. Perform basic Operations on Matrices.
2. Generate various signals and Sequences such as Unit Impulse, Unit Step, Square, Saw Tooth, Triangular, Sinusoidal, Ramp, Sinc function.
3. Perform operations on Signals and Sequences (Addition, Multiplication, Scaling, Shifting, Folding) and Compute Energy and Average Power.
3. Find the Even & Odd Parts of Signal or Sequence and Real & Imaginary Parts of a Signal.
5. Verify Linearity and Time Invariance Properties of a System.
6. Compute Unit Sample, Unit Step and Sinusoidal Responses of the given LTI System and Verify its Stability.
7. Find the Fourier Transform of a given Signal and plot its Magnitude and Phase spectrum.
8. Find Convolution of Signals and Sequences.
9. Perform Autocorrelation and Cross correlation of Signals and Sequences.
10. Sampling Theorem Verification.
11. Find Laplace Transform for a given function, Locate Zeros and Poles in Pole-Zero map (S-Plane) for the given Transfer Function and verify stability.
12. Find the response of Low pass and High pass filters with speech signal as input.



**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Luis F. Chaparro, *signals and systems using MATLAB*, Academic Press, 2011.
2. Michael J. Roberts, *Signals and Systems Analysis Using Transform Methods and MATLAB*, McGraw-Hill, Second Edition, 2012.

**SOFTWARE/Tools used:** MATLAB

**ADDITIONAL LEARNING RESOURCES:**

1. <http://ssl-iitg.vlabs.ac.in/>

**II B. Tech. – I Semester**  
**(19BT3MC01) ENVIRONMENTAL SCIENCE**  
(Mandatory Course)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | -          | 40          | 2 | - | - | - |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Natural resources; Ecosystems; Biodiversity; Environment pollution and control; Social issues and environment; Human population and environment.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze natural resources to solve complex environmental problems and natural resource management considering society, environment and sustainability.
- CO2: Analyze ecosystems and biodiversity to solve complex environmental problems by following environmental ethics considering society, environment and sustainability besides communicating effectively in graphical form.
- CO3: Analyze various types of pollution and their control measures to solve environmental problems through appropriate tools and techniques following latest developments considering society, ethics, environment and sustainability.
- CO4: Analyze social issues and its impact on environment, environmental acts to solve complex environmental problems considering society, environment and sustainability besides communicating effectively in graphical form.
- CO5: Analyze human population and its impact on environment to solve complex environmental problems through team work and using appropriate tools and techniques considering ethics, society, environment and sustainability.

**DETAILED SYLLABUS:**

**UNIT-I: NATURAL RESOURCES (07 Periods)**

Multidisciplinary nature of environment; Natural Resources: Renewable and non-renewable resources; Forest, Water, Mineral, Food and Energy resources -Causes, Effects, Remedies, Case studies; Role of an individual in conservation of natural resource and equitable use of resources for sustainable lifestyles.

**UNIT-II: ECOSYSTEMS AND BIODIVERSITY (07 Periods)**

**Ecosystems:** Concept of an ecosystem, Structure and function of an ecosystem - Producers, Consumers, Decomposers; Food chains, Food webs, Ecological pyramids – Types; Characteristic features, Structure and functions of forest ecosystem, Desert ecosystem, Aquatic ecosystem.

**Biodiversity:** Concept and value of biodiversity, Role of biodiversity in addressing new millennium challenges, Hot spots of biodiversity, Threats to biodiversity, Man-wild life conflicts, Endemic, Endangered and extinct species of India, Conservation of biodiversity – In-situ and ex-situ.

**UNIT-III: ENVIRONMENTAL POLLUTION AND CONTROL (06 Periods)**

Causes, Adverse effects and control measures of pollution - Air pollution, Water pollution, Soil pollution, Noise pollution, Thermal pollution, Nuclear pollution, Solid waste management – Urban waste, industrial waste; Latest developments in pollution control, Hazards and disaster management – Floods, Earthquakes, Tsunamis, Case studies.

**UNIT-IV: SOCIAL ISSUES AND THE ENVIRONMENT (06 Periods)**

Sustainable development, Urban problems related to energy, Environmental ethics – Issues, Solutions; Global warming, Acid rain, Ozone layer depletion, Nuclear accidents and case studies, Wasteland reclamation, Consumerism and waste products, Concept of green technologies, Environment justice: National Green Tribunal and its importance; Environment protection act, Air act, Water act, Wildlife protection act, Forest conservation act, Issues involved in enforcement of environmental legislation, Public environmental awareness.

**UNIT-V: HUMAN POPULATION AND THE ENVIRONMENT (04 Periods)**

Population growth, Population characteristics and variation among nations, Population explosion, Family welfare programme, Environment and human health, Human rights, Value education, HIV/AIDS, Women and child welfare, Role of information technology in environment and human health; Case studies - Field Work/Assignment/Seminar on Environmental assets – Water bodies/Forest/Grassland/Hill/Mountain.

**Total Periods: 30**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. AnubhaKaushik and C. P. Kaushik, *Perspectives in Environmental Studies*, New Age International (P) Ltd. Publications, 6<sup>th</sup> Edition, 2018.
2. ErachBarucha, *Environmental Studies*, Orient Blackswan, 2<sup>nd</sup> Edition, 2013.

**REFERENCE BOOKS:**

1. Cunningham W.P. and Cunningham M.A., *Principles of Environmental Science*, Tata McGraw-Hill Publishing Company, New Delhi, 8<sup>th</sup> Edition, 2016.
2. Benny Joseph, *Environmental Studies*, Tata McGraw-Hill, 2<sup>nd</sup> Edition, 2009.
3. M. Anji Reddy, *Text Book of Environmental Sciences and Technology*, BS Publications, 2014.
4. R. Rajagopalan, *Environmental Studies*, Oxford University Press, 2<sup>nd</sup> Edition, 2011.

**ADDITIONAL LEARNING RESOURCES:**

1. B. S. Chauhan, *Environmental Studies*, University Science Press, 2<sup>nd</sup> Edition, 2018.
2. Botkin and Keller, *Environmental Science: Earth as a Living Planet*, John Wiley & Sons, 8<sup>th</sup> International Student Edition, 2011.

**II B. Tech. - II Semester**  
**(19BT50201) CONTROL SYSTEMS**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Signals and Systems.

**COURSE DESCRIPTION:** Concepts of control system; Transfer function of various physical systems; Time response analysis; Frequency response analysis; Controller design and state space analysis.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Develop the mathematical model for various physical systems to determine the transfer function by applying the fundamental principles.
- CO2: Analyze the time response of first and second order system to evaluate steady state errors.
- CO3: Analyze stability of a system in time and frequency domains.
- CO4: Design compensator for a system using bode plot and root locus technique to meet the desired specification for sustainable operation.
- CO5: Apply state space method to model the system, to investigate controllability and observability.

**DETAILED SYLLABUS:**

**UNIT-I: MATHEMATICAL MODELING OF SYSTEMS (11 Periods)**

Introduction to control systems — Classification of open loop and closed loop control systems with examples; Modelling of physical systems — Transfer function of mechanical systems, electrical systems, Armature control and field control of DC motor – electrical analogy of mechanical systems; Block diagram reduction and Signal flow graph.

**UNIT-II: TIME RESPONSE ANALYSIS (07 Periods)**

Standard test signals; Time response of first and second order systems — Time-domain specifications, steady state error — static and dynamic error constants; Effects of Proportional, Integral and Derivative controllers.

**UNIT-III: STABILITY ANALYSIS (11 Periods)**

Introduction to stability, Routh-Hurwitz stability criterion – Relative stability; Root locus — rules to construct root loci, effect of pole and zero additions on the root loci. Frequency domain specifications, Bode plot, Polar plot and Nyquist Criterion, Correlation between time and frequency response.

**UNIT-IV: DESIGN OF COMPENSATORS (08 Periods)**

Introduction to Compensators, Lag, Lead, Lead-Lag; Compensator design using root locus and Bode plots.

**UNIT-V: STATE SPACE ANALYSIS****(08 Periods)**

Concept of state, state variable, state model; Transfer function to state space and state space to transfer function representation; Modelling of physical system in state space; State transition matrix and its properties – solution of state equations – diagonalization of state matrix; Controllability and observability using Kalman's test.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. A. Anand kumar, *Control Systems*, PHI learning Pvt Ltd., 2<sup>nd</sup> edition, 2014.
2. Katsuhiko Ogata, *Modern Control Engineering*, Pearson Education Publishers, 5<sup>th</sup> edition, 2010.

**REFERENCE BOOKS:**

1. Nagrath I.J. and Gopal M, *Control Systems Engineering*, New Age International Publications, 5<sup>th</sup> edition, 2010.
2. Richard C. Dorf and Robert H. Bishop, *Modern Control Systems*, Prentice Hall, 12<sup>th</sup> edition, 2010.
3. BenjaminC. Kuo and Farid Golnaraghi, *Automatic Control Systems*, John Wiley & Sons Publications, 8<sup>th</sup> edition, 2002.
4. Nagoorkani, *Control Systems*, RBA Publications, 2<sup>nd</sup> edition, 2006.

**ADDITIONAL LEARNING RESOURCES:**

1. NPTEL\_CONTROL SYSTEMS: <https://nptel.ac.in/courses/107/106/107106081/>
2. EDX\_INTRODUCTION TO CONTROL SYSTEMS: <https://www.edx.org/course/introduction-to-control-system-design-a-first-look>

**II B. Tech. - II Semester**  
**(19BT40401) ANALOG COMMUNICATIONS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Electronic Devices and circuits & Signals and Systems.

**COURSE DESCRIPTION:** Continuous wave modulations; Modulators and De-Modulators; Transmitters; Receivers; Noise performance; Pulse modulations; Multiplexing.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Evaluate total power, Bandwidth, and efficiency of Various Continuous Wave Modulations.
- CO2: Analyze the performance of different modulation systems by evaluating Signal to Noise Ratio.
- CO3: Analyze various Transmitter & Receivers circuits and receiver parameters.
- CO4: Analyze various pulse modulations and demodulations in transmission.

**DETAILED SYLLABUS:**

**UNIT-I: AMPLITUDE MODULATION & DEMODULATION (12 Periods)**

Elements of Communication Systems, Modulation, Need for Modulation, Amplitude Modulation (AM), Generation of AM waves - Square law modulator, switching modulators; Demodulation of AM waves - Square law detector, Envelope detector; Double sideband suppressed carrier (DSBSC), Generation of DSBSC waves - Balanced modulator, Ring modulator; Coherent detection of DSBSC waves - Costas receiver, squaring loop; Single sideband modulation (SSB), Generation of SSB waves - Frequency Discrimination Method, Phase Discrimination Method; Demodulation of SSB waves, Vestigial sideband (VSB) modulation & demodulation, Frequency division multiplexing.

**UNIT-II: ANGLE MODULATION & DEMODULATION (09 Periods)**

Basic Definitions Phase modulation (PM) and frequency modulation (FM), Single-Tone FM, Bandwidth of angle modulated waves - Narrow band frequency modulation (NBFM) and Wide band frequency modulation (WBFM); Transmission Bandwidth of FM Waves, Generation of FM waves - Indirect FM, Direct FM; Demodulation of FM Waves- Frequency Discrimination, PLL Demodulator.

**UNIT-III: NOISE IN COMMUNICATION SYSTEMS (09 Periods)**

Noise in Analog communication System, Signal to Noise ratio in AM, DSB & SSB System, Signal to Noise ratio in Angle Modulation System, Threshold effect in Angle Modulation System, Pre-emphasis & De-emphasis, FM Capture Effect.

**UNIT-IV: TRANSMITTERS AND RECEIVERS (10 Periods)**

Radio Transmitter - Classification of Transmitters, AM Transmitter, FM Transmitter; Radio Receivers - Receiver Types, Tuned radio frequency receiver, Super heterodyne receiver, Intermediate frequency, AGC, FM Receiver, Amplitude limiting; Comparison FM with AM Receiver, Radio Receiver measurements - Sensitivity, Selectivity, and fidelity.

**UNIT-V: PULSE MODULATION****(05 Periods)**

Analog pulse modulation schemes, Pulse amplitude modulation (PAM) & demodulation, Pulse-Time Modulation – Pulse Duration and Pulse Position modulations, and demodulation schemes; Time division multiplexing.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Simon Haykin, *Communication Systems*, Wiley-India edition, 3rd edition, 2010.
2. R.P. Singh, SP Sapre, *Communication Systems*, TMH, 2nd Edition, 2007.

**REFERENCE BOOKS:**

1. Herbert Taub & Donald L Schilling, *Principles of Communication Systems*, Tata McGraw Hill, 3rd Edition, 2009.
2. B. P. Lathi, *Modern Digital and Analog Communication Systems*, Oxford Univ. press, 3rd Edition, 2006.

**II B. Tech. – II Semester**  
**(19BT40402) ELECTRONIC CIRCUIT ANALYSIS AND DESIGN**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | 1 | - | 4 |

**PRE-REQUISITES:** Courses on Basic Electrical and Electronic Engineering & Electronic Devices and circuits.

**COURSE DESCRIPTION:** Demonstrate Single Stage Amplifiers; Multi Stage amplifiers; Frequency Response; Negative Feedback Amplifiers; Oscillators; Large Signal Amplifiers; Tuned Amplifiers.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design multistage amplifiers using voltage divider bias to determine the Gain, Bandwidth, Input and Output Impedances.
- CO2: Analyze transistors at high frequencies using Hybrid- $\pi$  Model to determine the gain and bandwidth.
- CO3: Design negative Feedback Amplifiers with high stability and positive feedback amplifiers to generate sustained oscillations.
- CO4: Analyze different classes of Power Amplifiers to improve power efficiency and understand frequency response of single stage tuned amplifiers.

**DETAILED SYLLABUS:**

**UNIT-I: DESIGN OF LOW FREQUENCY AMPLIFIERS (10 Periods)**

**BJT Amplifiers:** Classification of Amplifiers, Distortion in amplifiers, Different coupling schemes used in amplifiers, Design and analysis of RC coupled amplifier, effect of coupling and bypass capacitors, Multistage Frequency Effects, Cascode amplifier, Darlington pair, Bootstrapped Darlington circuit.

**MOSFET Amplifiers:** MOS Small signal model, Common source amplifier, Common Gate Amplifier, Source follower-simple problems.

**UNIT-II: TRANSISTOR AT HIGH FREQUENCY (10 Periods)**

The Hybrid- $\pi$  ( $\pi$ ) – Common Emitter transistor model, Hybrid- $\pi$  conductance, Hybrid- $\pi$  capacitances, validity of Hybrid- $\pi$  model, CE short circuit current gain, current gain with resistive load, single stage CE transistor amplifier response, Gain-bandwidth product, Emitter Follower at Higher Frequencies-problems.

**UNIT-III: NEGATIVE FEEDBACK AMPLIFIERS (09 Periods)**

Concepts of feedback – Classification of feedback amplifiers – General characteristics of negative feedback amplifiers – Effect of Feedback on Amplifier characteristics – Voltage series, Voltage shunt, Current series and Current shunt Feedback configurations – Method of analysis of Feedback amplifiers- Voltage series, Voltage shunt, Current series and Current shunt amplifiers-simple problems.



**UNIT-IV: OSCILLATORS****(07 Periods)**

Conditions for oscillations, Classification, RC phase shift oscillator, Wien bridge oscillator, generalized analysis of LC oscillators, Quartz, Hartley and Colpitts Oscillators, Frequency stability-simple problems.

**UNIT-V: LARGE SIGNAL AND TUNED AMPLIFIERS****(09 Periods)**

**Large Signal Amplifiers:** Classification, Class A Power Amplifier- Power conversion Efficiency, Transformer Coupled power Amplifier, Push Pull and Complimentary Symmetry Class B power amplifier, Class AB operation, Principle of operation of class –C Amplifier, Class D Power Amplifier, Class S power Amplifier, Transistor Power Dissipation, Heat Sinks.

**Tuned Amplifiers:** Introduction, Q-Factor, single stage Tuned Amplifiers- frequency response of tuned amplifiers.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Jacob Millman and Christos C.Halkias, *Integrated Electronics*, McGraw-Hill Education, 2<sup>nd</sup> edition, 2010.
2. Adel S. Sedra, Kenneth C. Smith , *Micro Electronic Circuits Theory and applications*, OXFORD international student edition 5<sup>th</sup> edition, ,2009

**REFERENCE BOOKS:**

1. Robert L. Boylestad and Louis Nashelsky, *Electronic Devices and Circuits Theory*, Pearson Education, 10<sup>th</sup> Edition, 2009.
2. David A. Bell, *Electronic Devices and Circuits*, Oxford University press, 5<sup>th</sup> Edition, 2014.
3. S. Salivahanan, N. Suresh Kumar, A Vallvaraj, *Electronic Devices and Circuits*, 3<sup>rd</sup> Edition, MC Graw Hill Education,2013

**II B. Tech. – II Semester**  
**(19BT40403) LINEAR AND DIGITAL IC APPLICATIONS**  
 (Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Network Analysis, Switching Theory and Logic Design & Electronic Devices and Circuits

**COURSE DESCRIPTION:** Linear & Non-Linear Applications of Op-Amp; IC 555 timer and phase locked loops; Application of PLL; filters; A-D & D-A Converters; CMOS and Bipolar Logic Interfacing; HDL with combinational and sequential logic design.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design different applications of op-amp, timer circuits and analyze PLL for specified applications.
- CO2: Design active filters using op-amp for audio processing applications.
- CO3: Analyze different analog to digital and digital to analog converters for data acquisition system.
- CO4: Analyze Verilog HDL capabilities to model digital circuits.
- CO5: Model combinational and sequential ICs using Verilog HDL to synthesize digital Circuits.

**DETAILED SYLLABUS:**

**UNIT-I: OP-AMP APPLICATIONS, IC555 TIMERS & PLL (11 Periods)**

Review of operational Amplifiers, Instrumentation amplifier, Log and Antilog amplifiers, RC phase shift oscillator.

Introduction to 555 timer, functional diagram, monostable and astable operations and applications. PLL - Introduction, block schematic, principles and description of individual blocks, Voltage Controlled Oscillator (IC 566).

**UNIT-II: FILTERS & D-A AND A-D CONVERTERS (09 Periods)**

**Filters:** First - order and second order LPF, HPF Butterworth Filters.

**D-A Converter:** Weighted resistor DAC, R-2R Ladder DAC.

**A-D Converters:** Flash type, Successive Approximation type and Dual slope ADC.

**UNIT-III: Verilog HARDWARE DESCRIPTION LANGUAGE (08 Periods)**

Introduction, Language Elements, operators, Expressions, Modeling-gate level modeling, data flow modeling, behavioral modeling, structural modeling.

**UNIT-IV: COMBINATIONAL LOGIC DESIGN APPLICATIONS (08 Periods)**

74x999 Adder and Subtractor, 74X138 3-to-8 Decoder, 74x148 Priority Encoder, 74x151 8X1 Multiplexer, 74x181 Arithmetic and Logic Unit, 74x280 9-Bit Parity Generator, 74x85

4-bit Comparator, Barrel Shifter using 74x151 multiplexer, Simple Floating-Point Encoder, Dual priority Encoder, modeling of circuits by using Verilog HDL.

#### **UNIT-V: SEQUENTIAL LOGIC DESIGN APPLICATIONS (09 Periods)**

Flip-Flops- JK-74LS109 and D-74LS74. Counters - 74x163 binary counter, Modulo-11 & 193 counters with a counting sequence, Modulo-8 Binary counter, Excess 3 decimal Counter using 74X163,74x169 up/down counter, Self-Correcting Ring & Johnson Counter,3-bit LFSR Counter.74x194 universal shift register, Modeling of circuits using Verilog HDL.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

#### **TEXT BOOKS:**

1. D. Roy Chowdhury, *Linear Integrated Circuits*, New Age International (p) Ltd, 5<sup>th</sup> Edition, 2018.
2. John F. Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4<sup>th</sup> Edition, 2008.

#### **REFERENCE BOOKS:**

1. Ramakanth A. Gayakwad, *Op-Amps & Linear Integrated Circuits*, Pearson Education, 4<sup>th</sup> Edition, 2015
2. J. Bhaskar, *A Verilog HDL Primer*, Star Galaxy Publishing, 3<sup>rd</sup> Edition, 2018

#### **ADDITIONAL LEARNING RESOURCES:**

1. <https://www.coursera.org/learn/electronics>
2. [https://www.youtube.com/results?search\\_query=james+roberge](https://www.youtube.com/results?search_query=james+roberge)

**II B. Tech. – II Semester**  
**(19BT40404) PROBABILITY AND STOCHASTIC PROCESSES**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Differential Equations and Multivariable Calculus.

**COURSE DESCRIPTION:** Probability theory; The Random Variable; Operations on Single and Multiple Random Variables; Temporal and spectral Characteristics of Stochastic Processes; Noise analysis.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the probability of occurrence of events in an experiment through axiomatic definitions, conditional, total probability and Bernoulli's trials.
- CO2: Evaluate Moments by performing various operations on single and multiple random Variables.
- CO3: Solve problems on stochastic process by analyzing the temporal and spectral characteristics.
- CO4: Estimate various noises in communications to improve signal to noise ratio.

**DETAILED SYLLABUS:**

**UNIT-I: PROBABILITY (08 Periods)**

Probability introduced through Sets and Relative Frequency, Experiments and Sample Spaces - Discrete and Continuous Sample Spaces; Events, Probability Definitions and Axioms, Mathematical Model of Experiments, Probability as a Relative Frequency, Joint Probability, Conditional Probability, Total Probability, Baye's Theorem, Independent Events, Bernoulli Trials.

**UNIT-II: THE RANDOM VARIABLE (10 Periods)**

Introduction, Random Variable Concept - Definition of Random variable, Condition for a function to be a Random Variable, Discrete and Continuous Random Variable; Distribution Function, Density Function Properties, The Gaussian Random Variable, Other distribution and density examples - Binomial, Poisson, Uniform, Exponential, Rayleigh; Conditional Distribution and Density Functions, Properties.

**Operations on One Random Variable:** Introduction, Expectation, Moments - Moments about Origin, Central Moments, Variance and Skew; Chebyshev's Inequality, Functions that give moments - Characteristic Function, Moment Generating Function; Transformations of a random Variable.

**UNIT-III: MULTIPLE RANDOM VARIABLES (10 Periods)**

**Multiple Random Variables:** Vector Random Variables, Joint Distribution and its Properties, Joint density and its Properties, Marginal Distribution and Density, Conditional Distribution and Density, Statistical Independence, Distribution and density of a sum of random variables, Central Limit Theorem.

**Operations on Multiple Random Variables:** Expected Value of a Function of Random Variables - Joint Moments about the Origin, Joint Central Moments, Joint Characteristic Functions, Jointly Gaussian Random Variables; Transformations of Multiple Random Variables, Linear Transformations of Gaussian Random Variables.

#### **UNIT-IV: STOCHASTIC PROCESSES-TEMPORAL AND SPECTRAL CHARACTERISTICS (10 Periods)**

Concept of Stochastic process, Stationary and Statistical Independence.

**TEMPORAL CHARACTERISTICS:** Time Averages and Ergodicity, Mean-Ergodic Processes, Correlation-Ergodic Processes, Correlation Functions- Auto correlation function and its properties, Cross correlation function and its properties, Covariance Functions; Gaussian Random Processes, Poisson Random Process.

#### **SPECTRAL CHARACTERISTICS**

Power density spectrum, properties of power density spectrum, relationship between power spectrum and auto correlation function, cross power density function, properties of cross power density function

#### **UNIT-V: NOISE ANALYSIS (07 Periods)**

Noise classification - Uncorrelated Noise, External Noise, Atmospheric Noise, Extraterrestrial Noise, Manmade Noise, Internal Noise, Shot Noise, Transit-Time Noise, Thermal noise,

Noise power, Noise voltage, Correlated Noise, Impulse Noise; Interference, Signal-to-Noise Power Ratio, Noise Factor and Noise Figure, Equivalent Noise Temperature.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

#### **TEXT BOOKS:**

1. Peyton Z. Peebles, *Probability, Random Variables & Random Signal Principles*, TMH, 4<sup>th</sup> Edition, 2017.
2. Wayne Tomasi, *Electronic communications systems*, Pearson Education, 5<sup>th</sup> Edition, 2004.

#### **REFERENCE BOOKS:**

1. George R. Cooper and Clare D. McGillem, *Probabilistic Methods of Signal and System Analysis*, Oxford, 3<sup>rd</sup> Edition, 2015.
2. Athanasios Papoulis and S. Unnikrishna Pillai, *Probability, Random Variables and Stochastic Processes*, PHI, 4<sup>th</sup> Edition, 2002.

**II B. Tech. – II Semester**  
**(19BT4BS01) MATERIAL SCIENCE**  
(Open Elective-1)  
(Common EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to Material Science and Engineering; Composite Materials; Smart Materials; Nano and Biomimetic Materials; Emerging Materials.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Attain the basic knowledge on composites, smart materials, biomimetic materials and nano materials.
- CO2: Demonstrate essential information about structure and properties of various composites used in various engineering applications.
- CO3: Understand the basic properties of electro-rheostatic, magneto-rheostatic and shape memory alloys used in device applications.
- CO4: Accomplish the basic knowledge in nano materials to familiarize various nano structured device applications.
- CO5: Outline the processing and properties of functionally graded materials and identify its applications in various fields.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO MATERIAL SCIENCE AND ENGINEERING**

**(08 Periods)**

Introduction - historical perspective - material science and engineering, classification of materials (metals, ceramics, polymers and composites) and advanced materials and their applications (biomaterials, smart materials and nano materials), modern materials needs. Processing, properties and applications of metals, polymers and ceramics (Qualitative).

**UNIT-II: COMPOSITE MATERIALS**

**(10 Periods)**

Composite Materials - Classification, Laminated composites and Reinforced composite materials – Classification, structure and properties of sandwich composites – applications (commercial Aircraft, Marine Grade Sandwich, Automobile Grade Sandwich and Wind Turbine Blades), properties and applications of Nano composites - Advantages and Limitations of composites.

**UNIT-III: SMART MATERIALS**

**(07 Periods)**

Classification of smart materials -Magneto-rheostatic (MR) and Electro-rheostatic (ER) materials - Shape Memory Alloys (SMA)- characteristics, Shape memory effect applications in different fields, advances in smart materials.

**UNIT-IV: NANO AND BIOMIMETIC MATERIALS****(10 Periods)**

**Nanomaterials:** Introduction, Low dimensional structures and energy quantization. Fabrication of nano materials - Lithographic technique using photons, metallic, semiconducting and magnetic properties of nano materials and applications (renewable energy and nano electro-mechanical systems (NEMS)).

**Biomimetic materials** – Introduction- classification and their applications (Lotus effect, Dolphin sound wave technology and viper as a model in defence)

**UNIT-V: EMERGING MATERIALS****(10 Periods)**

Functionally graded materials (FGM) - Types, processing, properties and potential applications, functionally graded fibre cement – structural material, Functionally Graded Nanoelectronic, Optoelectronic and Thermoelectric Materials (Qualitative) and its applications.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. William D Callister, David G Rethwisch, *Materials Science and Engineering*, Wiley, 9<sup>th</sup> edition, 2014.
2. K M Gupta, *Engineering Materials – Research, Applications and Advances*, CRC press (Taylor & Francis group), 2015.

**REFERENCE BOOKS:**

1. Sulabha K Kulkarni, *Nanotechnology: Principles and practices*, Springer, 9<sup>th</sup> edition, 2014.
2. Charles P. Poole and Frank J. Owens, *Introduction to Nanotechnology*, Wiley-Interscience, May 2003.
3. Sulabha K Kulkarni, *Nanotechnology: Principles and Practices*, Springer, 3<sup>rd</sup> edition, 2014.

**II B. Tech. - II Semester**  
**(19BT4HS02) BUSINESS COMMUNICATION AND CAREER SKILLS**  
(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Nature and Scope of Communication; Corporate Communication; Writing Business Messages & Documents; Careers and Résumés; Interviews.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge of professional communication by examining and applying the styles and strategies of business communication in Communication Networks and Writing Messages.
- CO2: Analyze the limitations of business communication by applying and demonstrating corporate communication aspects for effective communication through Interpersonal Communication, Informal Communication, and Crisis Management and Communication.
- CO3: Apply appropriate writing techniques for effective professional communication in preparing documents by demonstrating and examining Stages in Writing Business Messages, Strategies for Writing the Body of a Letter, and Structuring Résumés.
- CO4: Apply appropriate speaking techniques by examining and demonstrating effective communication in distinguished situations through Corporate Communication and Cross Cultural Communication

**DETAILED SYLLABUS:**

**UNIT-I: NATURE AND SCOPE OF COMMUNICATION (09 Periods)**

Introduction: Communication Basics - Functions of Communication - Communication Networks - Interpersonal Communication - Informal Communication - Communication Barriers - Roles of a Manager.

**UNIT-II: CORPORATE COMMUNICATION (09 Periods)**

Introduction: Corporate Communication - Cross-Cultural Communication; Concept & Styles - Corporate Communication Strategy - Corporate Citizenship - Crisis Communication: Case Study.

**UNIT-III: WRITING BUSINESS MESSAGES & DOCUMENTS (09 Periods)**

Introduction: Importance of Written Business Communication - Types of Business Messages - Five Main Stages of Writing Business Messages - Business Letter Writing; Kinds of Business Letters - Common Components of Business Letters - Strategies for Writing the Body of a Letter.



**UNIT-IV: CAREERS AND RÉSUMÉS****(09 Periods)**

Introduction - Career Building - Résumé Formats; Traditional, Electronic and Video Resumes - Sending Résumés - Follow-up Letters - Business Presentations and Speeches; Planning - Structuring - Organizing - Delivery.

**UNIT-V: INTERVIEWS****(09 Periods)**

Introduction - General Preparation for an Interview - Success in an Interview - Important Non-verbal Aspects - Types of Interviews - Styles of Interviewing - Types of Interviewing Questions - Online Recruitment Process.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Meenakshi Raman and Prakash Singh, *Business Communication*, Oxford University Press, New Delhi, 2<sup>nd</sup> edition, 2012.
2. Neera Jain and Sharma Mukherji, *Effective Business Communication*, Tata McGraw- Hill Education, Pvt. Ltd., New Delhi, 2012.

**REFERENCE BOOKS:**

1. Courtland L.Bovee et al., *Business Communication Today*, Pearson, New Delhi, 2011.
2. Krizan, *Effective Business Communication*, Cengage Learning, New Delhi, 2010.

**ADDITIONAL LEARNING RESOURCES**

1. <http://www.career.vt.edu/interviewing/TelephoneInterviews.html>
2. [http://job-search-search.com/interviewing/behavioral\\_interviews](http://job-search-search.com/interviewing/behavioral_interviews)
3. <https://goo.gl/laEHOY> (dealing with complaints)
4. <http://www.adm.uwaterloo.ca/infocecs/CRC/manual/resumes.html>
5. <https://goo.gl/FEMGXS>
6. <http://www.resumania.com/arcindex.html>

## II B. Tech. - II Semester

### (19BT4HS04) ENTREPRENEURSHIP FOR MICRO, SMALL AND MEDIUM ENTERPRISES

(Open Elective-1)

(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

#### PRE-REQUISITES: -

**COURSE DESCRIPTION:** Introduction to Entrepreneur Development; Idea generation and formation of Business Plan; Micro and Small Enterprises; Institutional Finance and Support to Entrepreneur; Woman Entrepreneurship.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Demonstrate knowledge in concepts, functions, Micro and Macro units, NGOs, Bharatiya Mahila Bank, Women Entrepreneurship, Schemes and Programmes.

CO2: Analyze the idea generation, business plans, business acumen, institutional finance and rural entrepreneurship.

#### DETAILED SYLLABUS:

##### UNIT-I: ENTREPRENEURSHIP DEVELOPMENT (09 Periods)

Introduction to Entrepreneurship Development - Concept of Entrepreneurship - Growth of Entrepreneurship in India - Factors affecting Entrepreneurship growth - Characteristics of an Entrepreneur - Functions of Entrepreneur - Entrepreneurial Decision Process - Types of Entrepreneurs - Distinction between an Entrepreneur and a manager.

##### UNIT-II: IDEA GENERATION AND FORMULATION OF BUSINESS PLANS

(09 Periods)

Sources of Ideas - Methods of idea generation - Steps in Setting up of a Small Business Enterprise - Formulation of Business Plan - Contents and Significance of Business Plan - Common Errors in Business Plan Formulation - The role of incubation centers for promoting entrepreneurship and start-ups.

##### UNIT-III: MICRO AND SMALL ENTERPRISES

(09 Periods)

Meaning and Definition - Micro and Macro units - Essentials - Features - Characteristics - Scope of Micro and Small Enterprises - Objectives of Micro Enterprises - Relationship between Micro and Macro Enterprises- Problems of Micro and Small Enterprises

##### UNIT-IV: INSTITUTIONAL FINANCE

(09 Periods)

Institutional Finance - Need-Scope-Services - Various Institutions offering Institutional support: - Small Industries Development Bank of India (SIDBI), State Industrial Development Corporations - Small Industries Development Organisation (SIDO) - Small Industries Service Institutes (SISIs) - SFCs - National Institute of Entrepreneurship and Small Business Development (NIESBUD) - Micro Units Development and Refinance Agency Bank (MUDRA).

**UNIT-V: WOMEN & RURAL ENTREPRENEURSHIP****(09 Periods)**

Concept of Women entrepreneur - Functions of Women entrepreneurs - Growth of women entrepreneurship in India - Challenges of Women entrepreneurs- Programmes supporting women entrepreneurship – Rural Entrepreneurship – Meaning, Need for Rural entrepreneurship, Problems of rural entrepreneurship, Role of NGOs, Role of Bharatiya Mahila Bank for encouraging Women Entrepreneurs – Micro Finance & Self Help Groups (Basic Concepts).

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Dr.S.S.Khanka, *Entrepreneurial Development*, S. Chand and Company Ltd, Revised edition, 2012.
2. MadhurimaLall & ShikhaSahai, *Entrepreneurship*, Excel Books India, 4<sup>th</sup> edition, 2014.

**REFERENCE BOOKS:**

1. Nandan, H., *Fundamentals of Entrepreneurship*, PHI Learning Pvt. Ltd., New Delhi, 3<sup>rd</sup> edition, 2013.
2. BholanathDutta, *Entrepreneurship Management – Text and Cases*, Excel Books, 3<sup>rd</sup> edition, 2015.

**II B. Tech. - II Semester**  
**(19BT4HS06) GERMAN LANGUAGE**  
 (Open Elective-1)  
 (Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Oral communication; Basic grammar; Basic writing; Berufsdeutsch (Business German)

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Communicate everyday using familiar words with expressions and simple sentences.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION (09 Periods)**

Introduction - German alphabets, numbers, days in a week, names of months, seasons. Grammar: Nouns –(i)Nominative case and (ii) Nominative personal pronouns, simple sentence, Verb Conjugation 1<sup>st</sup> and 2<sup>nd</sup> type, verb Conjugation 3<sup>rd</sup> type, 'Wh' questions (simple sentences) Nominative (definite and indefinite) Articles

**UNIT-II: CITY AND FOOD (09 Periods)**

In the city: naming places and buildings, means of transport, basic directions. Food: drink, groceries and meals. Apartments: rooms, furniture, colours.

Grammar: Nouns-articles negation–(kein and nicht); imperative and the accusative case; Nominative Possessive Pronouns.

**UNIT-III: DAY TO DAY CONVERSATIONS (09 Periods)**

Everyday life, telling time, making appointments, leisure activities, and celebrations. Different types of professions, Health and the body, Holiday and weather, Clothes and Dresses.

**UNIT-IV: BASIC GRAMMAR (09 Periods)**

Grammar: Possessive articles, Prepositions (am, um, von. bis); Modal verbs, Separable verbs, the accusative, past tense of 'to have' and 'to be', the imperative sentences, dative case, perfect tense.

**UNIT-V: BASIC WRITING (09 Periods)**

Translation from English to German and German to English, Contacts, Writing letters and Email Writing.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOK:**

1. Heuber,Tangram Aktuelleins, HeuberVerlag Publications, 2011.

**REFERENCE BOOKS:**

1. Anta Kursisa, Gerhard Newner, Sara vicenta, Fir fuer Deutsch 1 und Deutsch 2, HeuberVerlag Publications, 2005.
2. Herman Funk, Studio D A1 Cornelsen, GOYAL SAAB Publication, Year 2011.

**II B. Tech. - II Semester**  
**(19BT4HS08) INDIAN HISTORY**  
 (Open Elective-1)  
 (Common to EEE, ECE and EIE)

|            |            |             |   |   |   |   |
|------------|------------|-------------|---|---|---|---|
| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**CORSE DESCRIPTION:** Introduction; Ancient India; Classical and Medieval era; Modern India; India after independence.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate contextual knowledge on evolution of ancient and medieval Indian History and acquire awareness on societal and cultural issues.
- CO2: Analyze the situations before and after Independence and assess the societal reforms implemented in India after Independence.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION (08 Periods)**

Elements of Indian History; History Sources: Archaeology, Numismatics, Epigraphy & Archival research; Methods used in History; History & historiography; sociological concepts-structure, system, organization, social institutions, Culture and social stratification (caste, class, gender, power), State& Civil Society.

**UNIT-II: ANCIENT INDIA (09 Periods)**

Mohenjo-Daro civilization; Harappa civilization; Mauryan Empire.

**UNIT-III: CLASSICAL & MEDIEVAL ERA (12 Periods)**

Classic Era (200 BC - 1200 AD); Hindu - Islamic Era (1200 - 1800 AD).

**UNIT-IV: MODERN INDIA (06 Periods)**

Age of Colonialism (17th - 19th centuries); First war of Indian Independence; Freedom Struggle (1857-1947).

**UNIT-V: INDIA AFTER INDEPENDENCE (1947 - ) (10 Periods)**

The Evolution of the Constitution and Main Provisions; Consolidation of India as a Nation; Politics in the States; Indian economy; Modernization and globalization, Secularism and communalism, Nature of development, Processes of social exclusion and inclusion, Changing Nature of work and organization.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOK:**

1. K. Krishna Reddy, *Indian History*, Tata McGraw-Hill, 21<sup>st</sup> reprint, 2017.

**REFERENCE BOOKS:**

1. Guha, Ramachandra, *India after Gandhi*, Pan Macmillan, 2007.
2. Thapar, Romila, *Early India*, Penguin, 2002.

**II B. Tech. - II Semester**  
**(19BT4HS10) PERSONALITY DEVELOPMENT**

(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Soft Skills Laboratory

**COURSE DESCRIPTION:** Personalities and Leadership Qualities; Self Esteem and self Development; Attitude; Communication Relationship; Critical Work Skills and Ethics.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge of leadership qualities by examining and applying personality traits through Positive self esteem, Open Communication and Self-Righteousness.
- CO2: Analyze the limitations of Attitudes by applying and demonstrating communication traits through Decision Making, Ethics and Self Actualization.
- CO3: Apply appropriate Analyzing techniques for comprehending different personalities by examining Positive and Negative Characteristic Traits and demonstrating through Leadership Styles, Mentoring and Behaviour Modification.
- CO4: Apply appropriate techniques in Solving Problems by examining and demonstrating Time Management, Stress Management and Anger Management.

**DETAILED SYLLABUS:**

**UNIT-I: PERSONALITIES AND LEADERSHIP QUALITIES (09 Periods)**

Introduction: Different Personalities - Personality Analysis - Freudian Analysis – Vedantic Concept: Swamy Vivekananda- Personality Begets - Types- Leadership Qualities – Decision Making - Case Studies: Personalities.

**UNIT-II: SELF ESTEEM AND SELF DEVELOPMENT (09 Periods)**

**Know Yourself:** Self Image - Positive Self Esteem -Turn Failure into Success - Be Sensitive to Feedback - Build Self Confidence – Self Actualization - Set Goals - Action Plans - Accountability – Behavior Modification – Mentoring - Learning- Counseling – Challenge yourself with Aptitude Tests and Internships.

**UNIT-III: ATTITUDE (09 Periods)**

Importance – Difference between Behavior and Attitude - Changing Negative Attitude- Impact of Attitudes on others - Unproductive Attitudes –Assess your Behaviour.

**UNIT-IV: COMMUNICATION RELATIONSHIP****(09 Periods)**

Introduction – Positive and Negative Characteristic Traits - Grapevine Communication – Open Communication; Team Player - Leadership styles – Performance Expectations - Electronic Communication; Text Messaging – Voicemail – E-Mail

**UNIT-V: CRITICAL WORK SKILLS AND ETHICS****(09 Periods)**

Time Management - Balancing Life and Work - Stress Management - Anger Management - Making Decisions and Solving Problems - Developing Creativity - Ethics and Self-Righteousness – Being Judgemental in the Real World - Striving for Integrity.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Harold R. Wallace and L. Ann Masters, *Personal Development for Life and Work*, Cengage Learning, Delhi, 10<sup>th</sup> edition Indian Reprint, 2011. (6<sup>th</sup> Indian Reprint 2015)
2. Barun K. Mitra, *Personality Development and Soft Skills*, Oxford University Press, 2011.

**REFERENCE BOOKS:**

1. K. Alex, *Soft Skills*, S. Chand & Company Ltd, New Delhi, 2<sup>nd</sup> Revised Edition, 2011.
2. Stephen P. Robbins and Timothy A. Judge, *Organizational Behaviour*, Prentice Hall, Delhi, 16<sup>th</sup> edition, 2014.

**ADDITIONAL LEARNING RESOURCES**

1. <https://www.ncbi.nlm.nih.gov/pubmed/25545842>



**II B. Tech. - II Semester**  
**(19BT4HS12) WOMEN EMPOWERMENT**  
 (Open Elective-1)  
 (Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Concept & Framework, Status of Women, Women's Right to work, International Women's Decade, and Women Entrepreneurship.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate the characteristics of empowered women, their achievements, and frame work for women empowerment, legal laws, and political status of women.
- CO2: Apply the knowledge of women rights to address various societal issues and obstacles in different fields including science and technology.
- CO3: Understand the significance of participation in policy debates, National conferences and common forums for women's' equality and development.
- CO4: Analyze the concept of women entrepreneurship, government schemes and entrepreneurial challenges and opportunities.

**DETAILED SYLLABUS:**

**UNIT-I: CONCEPT & FRAMEWORK (09 Periods)**

Introduction- Empowered Women's Characteristics- Achievements of Women's Empowerment **Concept of Empowerment:** Meaning& Concept- Generalizations about Empowerment -Empowerment Propositions - Choices women can make for empowerment - Women's participation in decision making, development process & in Governance. **Framework for Women's Empowerment** - Five levels of equality- Tenets of Empowerment- Elements - Phases and aspects - Techniques - Categories and Models - Approaches.

**UNIT-II: STATUS OF WOMEN (09 Periods)**

**Legal Status:** Present Scenario- Call for Social change- Significant trends - Legal & Schemes - Personal Law- Joint Family- Criminal Law- Shift towards Dowry - Deterrent Punishment - Criminal Law(II Amendment) - Discrimination in Employment

**Political Status:** Present Scenario - Political Participation & its Nature- Socio-economic Characteristics - Political Mobilization: Mass Media - Campaign Exposure - Group Orientation - Awareness of issues and participation - Progress & Future Thrust.

**UNIT-III: WOMEN'S RIGHT TO WORK (09 Periods)**

Introduction- Present Scenario - Changes in Policy & Programme - National Plan of Action- Women's Cells and Bureau - Increase in work participation rate- Discrimination in labour market - Women in unorganized sector - Issues and Obstacles- Women in Education -

Women in Science & Technology - **Case Study:** Linking Education to Women's Access to resources.

#### **UNIT-IV: WOMEN'S PARTICIPATORY DEVELOPMENT (09 Periods)**

Dynamics of social change- conscious participation - Information Explosion - Organized Articulation - National Conference - Common Forums - Participatory Development - New Issues Identified - Role of other Institutions.

#### **UNIT-V: WOMEN ENTREPRENEURSHIP (09 Periods)**

Introduction-Definition-Concept- Traits of women Entrepreneurs- Role of women Entrepreneurs in India -Reasons of Women Entrepreneurship- Government schemes & Financial Institutions to develop Women Entrepreneurs - Key policy recommendations - Project Planning-Suggestions and measures to strengthen women entrepreneurship - Growth & Future challenges - Training and Opportunities - **Case Study:** Training Women as Hand-pump Mechanics- **Case Study** : Literacy for Empowering Craftswomen

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. Nayak Sarojini, Nair Jeevan(2017), "*Women's Empowerment in India*". Pointer Publishers, Jaipur
2. Sahay Sushama (2013), "*Women and Empowerment*" Discovery Publishing House, New Delhi.

#### **REFERENCE BOOKS:**

1. Baluchamy. S (2010), "*Women's Empowerment of Women*". Pointer Publishers, Jaipur.
2. Khobragade Grishma (2020), "*Women's Empowerment: Challenges and Strategies Empowering Indian Women*", Books clinic Publishing, Chhattisgarh.
3. <https://www.economicdiscussion.net/entrepreneurship/women-entrepreneurs-in-india>
4. <https://www.businessmanagementideas.com/entrepreneurship-2/women-entrepreneurs>

**II B. Tech. - II Semester**  
**(19BT4HS14) CONSTITUTION OF INDIA**  
(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Preamble and its Philosophy; Union Legislature; Federalism in India; Judiciary and Public Services; Nation Building

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Gain knowledge in Parliamentary proceedings, Election Commission, Public Services and Foreign Policy of India.
- CO2: Apply the reasoning informed by the various aspects in the Constitution, its provisions to assess societal issues and the consequent responsibilities relevant to the professional engineering practice.

**DETAILED SYLLABUS:**

**UNIT-I: PREAMBLE AND ITS PHILOSOPHY (08 Periods)**

Introduction and Evolution of Indian Constitution, preamble and its philosophy

**UNIT-II: UNION LEGISLATURE (09 Periods)**

The Parliament, Parliamentary Structure, Process of Legislation; President of India – Powers and Functions; Vice President, Prime Minister and Council of Ministers; Constitution Amendment Procedure and Financial Legislation.

**UNIT-III: FEDERALISM IN INDIA (10 Periods)**

Features of Federal System, Centre-State relations, Directive Principles of State Policy, Administrative Relationship between Union and States; Governors - Powers and Functions; State Legislature - Composition and powers; Chief Ministers - Powers and Functions, Council of Ministers; The Election Commission – Powers and Functions.

**UNIT-IV: JUDICIARY AND PUBLIC SERVICES (09 Periods)**

The Union Judiciary - Supreme Court and High Court; Fundamental Rights and Duties All India Services - Central Civil Services - State Services - Local Services.

**UNIT-V: INTERNATIONAL PARTICIPATION (09 Periods)**

Foreign Policy of India; International Institutions Influence: UNO, WTO, WHO, SAARC, International Summits: BRICS, NSS, UNEP – India's Role in International Negotiations; Environmentalism in India.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOK:**

1. Brijji Kishore Sharma, *Introduction to the Constitution of India*, Prentice Hall of India, 2005.

**REFERENCE BOOK:**

1. Mahendra Pal Singh, V. N. Shukla's, *Constitution of India*, Eastern Book Company, 2011.
2. Pandey J. N., *Constitutional Law of India* - Central Law Agency, 1998.

**II B. Tech. - II Semester**  
**(19BT40205) RELIABILITY AND SAFETY ENGINEERING**

(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Differential Equations and Multi-Variable Calculus & Transformation Techniques and Linear Algebra.

**COURSE DESCRIPTION:** Fundamentals of reliability engineering; Network modeling and reliability evaluation; Markov chain and Markov processes; basics of safety concepts and safety techniques and applications.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Develop mathematical model of a network to evaluate the parameters for assessing the reliability of a system.
- CO2: Analyze the time dependent/independent characteristics of a repairable system and frequency durations techniques to assess reliability.
- CO3: Understand various safety management, policy, and planning strategies for personal and industrial safety.
- CO4: Understand various safety and hazard identification techniques and follow appropriate safety measures in industry and society.

**DETAILED SYLLABUS:**

**UNIT-I: FUNDAMENTALS OF RELIABILITY ENGINEERING (09 Periods)**

Random variables, probability concepts, rules for probabilities of events. Probability density and distribution functions. Binomial distribution - Expected value and standard deviation for binomial distribution. Reliability functions,  $f(t)$ ,  $F(t)$ ,  $h(t)$  - Relationship between these functions, Exponential density and distribution functions, expected value and standard deviation of exponential distribution. Measures of reliability - MTTF, MTTR, MTBF. Bathtub curve.

**UNIT-II: NETWORK MODELING AND RELIABILITY EVALUATION (09 Periods)**

Basic concepts - Evaluation of network reliability/unreliability, series systems, parallel systems, series - Parallel configuration systems. Redundant systems and its types. Evaluation of network Reliability / Unreliability using conditional probability method, tie-set and cut-set based approach, complete event tree and reduced event tree methods.

**UNIT-III: MARKOV CHAIN AND MARKOV PROCESSES (09 Periods)**

Basic concepts, stochastic transitional Probability matrix, time dependent probability evaluation, Limiting State Probability evaluation, Absorbing states. Modelling concepts - State space diagrams, time dependent reliability evaluation of single component repairable model, two component repairable model. Frequency and duration techniques.

**UNIT-IV: BASICS OF SAFETY CONCEPTS****(09 Periods)**

Introduction, goals, need for safety, history of safety movement - evolution of modern safety concept, general concepts of safety management. Planning for safety-productivity, quality and safety, line and staff functions, budgeting for safety, safety policy.

**UNIT-V: SAFETY TECHNIQUES AND APPLICATIONS****(09 Periods)**

Introduction to safety techniques, Incident Recall Technique (IRT), disaster control, job safety analysis, safety survey, safety inspection, safety sampling, evaluation of performance of supervisors on safety. Hazard identification techniques, components of safety audit, types of audit, audit methodology, process of safety reporting. Applications of industrial Safety, environmental safety, health safety, electrical safety, fire safety.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Roy Billinton and Ronald N Allen, *Reliability Evaluation of Engineering Systems*, 2<sup>nd</sup> edition, Springer, New York, 2013.
2. Frank R. Spellman, Nancy E. Whiting, *Safety Engineering: Principles and Practices*, 3<sup>rd</sup> edition, Rowman & Littlefield, 2018.

**REFERENCE BOOKS:**

1. Charles E. Ebeling, *An introduction to reliability and maintainability engineering*, 2<sup>nd</sup> edition Tata McGraw-Hill Education, 2010.
2. Dan Petersen, *Techniques of Safety Management: A Systems Approach*, 4<sup>th</sup> edition American Society of Safety Engineers, 2003.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/105/108/105108128/>
2. <https://nptel.ac.in/courses/110/105/110105094/>
3. <https://www.youtube.com/watch?v=uutg8jKrL9w>
4. <https://www.youtube.com/watch?v=c-iZ2BAXPw>
5. <https://www.youtube.com/watch?v=GeMCF3s5EDk>
6. <https://www.youtube.com/watch?v=xYWyyype7cxE>

**II B. Tech. - II Semester**  
**(19BT50107) ENVIRONMENTAL POLLUTION AND CONTROL**  
(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:** Fundamentals of air pollution; Dispersion of pollutants; Effects and control of air pollution; Water pollution; Soil pollution and control; Municipal solid waste management.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze air and noise pollution using appropriate tools and techniques to solve complex environmental issues following relevant standards considering society, environment and sustainability besides communicating effectively in graphical form.
- CO2: Analyze air and noise pollution control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.
- CO3: Analyze water pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.
- CO4: Analyze soil pollution and its control measures using appropriate tools and techniques to solve complex environmental issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.
- CO5: Analyze solid waste and its management measures using appropriate tools and techniques to solve solid waste disposal issues following relevant standards and latest developments considering society, environment and sustainability besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT-I: AIR AND NOISE POLLUTION (08 Periods)**

**Air Pollution:** Scope, Significance, Classification, Sources – Line, Area, Stationary, Mobile; Effects of air pollutants on man, material and vegetation; Global effects of air pollution; Air pollution meteorology - Lapse rate, Inversion, Plume pattern; Dispersion of air pollutants - Dispersion models and applications; Ambient air quality standards.

**Noise Pollution:** Sound pressure, Power and intensity, Impacts of noise, permissible limits of noise pollution, measurement of noise, Noise standards.

**UNIT-II: AIR AND NOISE POLLUTION CONTROL****(10 Periods)**

Self cleansing properties of the environment, Dilution method, Control at source, Process changes and equipment modifications, Control of particulates–Types of equipment, Design and operation – Settling chambers, Centrifugal separators, Bag house filters, Wet scrubbers, Electrostatic precipitators; Control of gaseous pollutants – Adsorption, Absorption, Condensation, Combustion; Control of air pollution from automobiles, Control of noise pollution, Case studies, Latest developments in the air and noise pollution control.

**UNIT-III: WATER POLLUTION AND CONTROL****(10 Periods)**

Water pollution – Sources, Causes, Effects; Surface and groundwater quality – Physical, Chemical, Biological; Drinking water quality standards, Water purification – Processes, Engineered systems – Aeration, Solids separation, Settling operations, Coagulation, Softening, Filtration, Disinfection; Wastewater – Sources, Causes, Effects, Treatment process and disposal – Primary, Secondary, Tertiary; Case studies, Latest developments in the water pollution control.

**UNIT-IV: SOIL POLLUTION AND CONTROL****(08 Periods)**

Soil pollutants, Sources of soil pollution, Causes, Effects and control of soil pollution, Diseases caused by soil pollution, Methods to minimize soil pollution, Effective measures to control soil pollution, Soil quality standards, Case studies, Latest developments in the soil pollution control.

**UNIT-V: MUNICIPAL SOLID WASTE MANAGEMENT****(09 Periods)**

Municipal solid waste – Types, Composition and characteristics; Methods of collection and transportation; Methods of disposal – Open dumping, Sanitary landfill, Composting and Incineration; Utilization -6R Concept, Recovery and recycling and Energy Recovery; Latest developments in solid waste management.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Peavy, H. S, Rowe, D. R., and Tchobanoglous, G., *Environmental Engineering*, McGraw Hill Inc., 1985.
2. C.S.Rao, *Environmental Pollution Control Engineering*, New Age International Pvt. Ltd., 2<sup>nd</sup> Edition, 2007.
3. Ibrahim A. Mirsa, *Soil Pollution: Origin, Monitoring & Remediation*, Springer, UK, 2<sup>nd</sup> Edition, 2008.

**REFERENCE BOOKS:**

1. M.N. Rao and H.V.N. Rao, *Air Pollution*, Tata McGraw–Hill Education Pvt. Ltd., 19<sup>th</sup> Edition, 2010.
2. Daniel Vallero, *Fundamentals of Air Pollution*, Academic Press (Elsevier), 5<sup>th</sup> Edition, 2014.
3. S.M.Khopkar, *Environmental Pollution Monitoring and Control*, New Age International Pvt. Ltd., 2<sup>nd</sup> Edition, 2007.
4. V. M. Domkundwar, *Environmental Engineering*, Dhanpat Rai & Co. Pvt. Ltd., New Delhi, 2014.

**ADDITIONAL LEARNING RESOURCES:**

1. *National Ambient Air Quality Standards*, Central Pollution Control Board, New Delhi
2. *Specifications for Drinking Water Standards*, IS10500:2012
3. *Solid Waste Management Rules*, 2016



**II B. Tech. - II Semester**  
**(19BT50108) PLANNING FOR SUSTAINABLE DEVELOPMENT**  
(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:** Sustainable development; Environmental impact; Sustainable Policies; Governance; Theories and strategies; Media and education for sustainability.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Compare sustainable development theories in national and global context to protect the society and environment.
- CO2: Analyze the unforeseen environmental impacts on sustainable development to protect the society and environment.
- CO3: Analyze policies and governance for sustainable development considering ethics, economics, society and environment.
- CO4: Analyze systems and strategies for sustainable development using appropriate tools and techniques considering ethics, economics, society and environment.
- CO5: Analyze the role of media and education in sustainable development using appropriate tools and techniques considering ethics, society and environment besides communicating effectively.

**DETAILED SYLLABUS:**

**UNIT-I: SUSTAINABLE DEVELOPMENT (09 Periods)**

Definition and concepts of sustainable development, Capitalization of sustainability- National and global context; Sustainable development goals, Emergence and evolution of sustainability and sustainable development, Theories of sustainability, Case studies.

**UNIT-II: ENVIRONMENTAL IMPACT (09 Periods)**

Climate change – Science, Knowledge and sustainability; Unforeseen environmental impacts on development, Challenges of sustainable development, Centrality of resources in sustainable development, Case studies.

**UNIT-III: SUSTAINABLE POLICIES AND GOVERNANCE (09 Periods)**

Governance - Democracy and Eco-welfare; Global civil society and world civil politics, Civic environmentalism, Policy responses to sustainable development, Economics of sustainability, Social responsibility in sustainability, National action, ISO 14001: Environmental management system.

**UNIT-IV: SUSTAINABLE SYSTEMS AND STRATEGIES (09 Periods)**

Need for system innovation, Transition and co-evolution, Theories and methods for sustainable development, Strategies for eco-innovation, Ecological foot print analysis, Socio ecological indicators – Eco labels; Policy programmes for system innovation, Case studies.

**UNIT-V: MEDIA AND EDUCATION FOR SUSTAINABILITY****(09 Periods)**

Role of emerging media, Remarkable design and communication art, Activism and the public interest, Education for sustainability, Participation in decision making, Critical thinking and reflection, Case studies.

**Total Periods: 45*****Topics for Self-Study are provided in the Lesson Plan*****TEXT BOOKS:**

1. John Blewitt, *Understanding Sustainable Development*, Earth Scan Publications Ltd., 2<sup>nd</sup> Edition, 2008.
2. Jennifer A. Elliot, *An Introduction to Sustainable Development*, Earth Scan Publications Ltd., 4<sup>th</sup> Edition, 2006.

**REFERENCE BOOKS:**

1. Peter Rogers, Kazi F Jalal and John A Boyd, *An Introduction to Sustainable Development*, Earth Scan Publications Ltd., 2006.
2. Simon Dresner, *The Principles of Sustainability*, Earth Scan Publications Ltd., 2<sup>nd</sup> Edition, 2008.
3. Peter Bartelmus, *Environment Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, 3<sup>rd</sup> Edition, 2003.
4. Gabriel Moser, Enric Pol, Yvonne Bernard, Mirilia Bonnes, Jose Antonio Corraliza and Maria Vittoria Giuliani, *People Places and Sustainability*, Hogrefe & Huber Publishers, 2<sup>nd</sup> Edition, 2003.

**ADDITIONAL LEARNING RESOURCES:**

1. Anil Markandya , *Climate Change and Sustainable Development: Prospects for Developing Countries*, Routledge, 2002

**II B. Tech. - II Semester**  
**(19BT50109) RURAL TECHNOLOGY**  
(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:** Technology for rural development; Nonconventional energy; Technologies for rural development; Community development; IT in rural development.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Compare various technologies for rural development by solving rural problems through different schemes by considering ethics, society, environment and sustainability.
- CO2: Analyze non conventional energy sources using appropriate tools and techniques to solve rural energy problems considering society, environment and sustainability besides communicating effectively in graphical form.
- CO3: Select appropriate technologies in different areas of rural development to solve rural issues following latest developments considering society, environment and sustainability.
- CO4: Relate water conservation, health, safety and rural employment issues for community development to solve rural problems through appropriate technologies considering ethics, society, environment and sustainability.
- CO5: Analyze the impact of IT, public and private partnership on rural development to solve complex rural problems using appropriate tools and techniques considering ethics, society, environment and sustainability.

**DETAILED SYLLABUS:**

**UNIT-I: TECHNOLOGY FOR RURAL DEVELOPMENT (09 Periods)**

India - Technology and rural development, Pre and post independence period, Rural India Life, Indian farmer, Role of science and technology in rural development, Rural technology and poverty eradication, Rural business hubs, Technology in improving rural infrastructure, Various organizations related to innovation, Issues of technology transfer - CAPART, NABARD, CSIR, NIF.

**UNIT-II: NON CONVENTIONAL ENERGY (09 Periods)**

Definition of energy, Types of alternative sources of energy, Sources of non conventional energy – Solar energy: Solar pump in agriculture, Solar dryer, Solar cooker, Solar heater; Biogas, Recycling and management, Wastes conservation, Assessment and production of biomass products and their utilization.

### **UNIT-III: TECHNOLOGIES FOR RURAL DEVELOPMENT (09 Periods)**

Food and agro based technologies, Tissue culture, Nursery, Building and construction technologies, Cultivation and processing of economic plants, Cottage and social industries, Latest developments in rural technologies.

### **UNIT-IV: COMMUNITY DEVELOPMENT (09 Periods)**

Water conservation, Rain water Harvesting, Drinking water Standards and simple treatments used, Environment and Sanitation, Bio fertilizers, Medical and aromatic plants, Employment generating technologies–Apiculture, Pisciculture, Aquaculture.

### **UNIT-V: IT IN RURAL DEVELOPMENT (09 Periods)**

Role of information technology (IT) in rural areas, Impact of IT in rural development, Need and necessity of technology, Corporate social responsibilities, Private sector participation (Activities in different spheres: Employment, Education, Health, Agriculture and service sectors) and SaansadAdarsh Gram Yojana (SAGY), Village adoption schemes.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. M. S. Viridi, *Sustainable Rural Technologies*, Daya Publishing House, 2<sup>nd</sup> Edition 2018.
2. S. V. Prabhath and P. Ch. Sita Devi, *Technology and Rural India*, Serials Publications, 1<sup>st</sup> Edition, 2012.

#### **REFERENCE BOOKS:**

1. R. Chakravarthy and P. R. S. Murthy, *Information Technology and Rural Development*, Pacific Book International, 1<sup>st</sup> Edition, 2012.
2. Shivakanth Singh, *Rural Development Policies and Programmes*, Northern Book Centre, 1<sup>st</sup> Edition, 2002.
3. Katar Singh and Anil Shishodia, *Rural Development: Principles, Policies, and Management*, SAGE Publications India Private Limited, 4<sup>th</sup> Edition, 2016.
4. A. Vinayak Reddy, M. Yadagira Charyulu, *Rural Development in India: Policies & Initiatives*, New Century Publications, 1<sup>st</sup> Edition, 2008.

#### **ADDITIONAL LEARNING RESOURCES:**

1. L. M. Prasad, *Principles and Practice of Management*, S. Chand & Sons, 9<sup>th</sup> Edition, 2019.
2. Venkata Reddy, K., *Agriculture and Rural Development - Gandhian Perspective*, Himalaya Publishing House, 1<sup>st</sup> Edition, 2017.

**II B. Tech. - II Semester**  
**(19BT50505) ETHICAL HACKING**  
(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:** Ethical hacking, Network and computer attacks, Foot printing, Social engineering, Port scanning, System hacking, Sniffers, Denial of service, Hacking web servers, Wireless hacking, Cryptography, Network Protection System.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on the computer security, social engineering and the intent of ethical hacking.
- CO2: Select and apply foot printing and port scanning tools to discover vulnerabilities of the computer system.
- CO3: Investigate hacking techniques and tools to maintain computer security.
- CO4: Analyze cryptosystems and network protection systems for information security and intrusion prevention.

**DETAILED SYLLABUS:**

**UNIT-I: ETHICAL HACKING, NETWORK AND COMPUTER ATTACKS (09 Periods)**

**Introduction to Ethical Hacking:** The role of security and penetration testers, Penetration-Testing methodologies, What you can and cannot do legally.

**Network and Computer Attacks:** Malicious software, Trojans, Backdoors, Viruses, and Worms, Protection against malware attacks, Intruder attacks on networks and computers, Addressing physical security.

**UNIT-II:-TCP/IP CONCEPTS AND SOCIAL ENGINEERING (09 Periods)**

**TCP/IP Concepts:** Overview of TCP/IP – Application layer, Transport layer, Internet layer; IP addressing – Planning IP address assignments, IPv6 addressing.

**Social Engineering:** What is social engineering, What are the common types of attacks, Understand insider attacks, Understand identity theft, Describe phishing attacks, Understand online scams, Understand URL obfuscation, Social engineering countermeasures.

**UNIT-III: FOOTPRINTING AND PORT SCANNING (09 Periods)**

**Foot printing:** Using web tools for foot printing, Conducting competitive intelligence, Using domain name system zone transfers.

**Port Scanning:** Port scanning, Using port scanning tools, Conducting ping sweeps, Understanding scripting.

**UNIT-IV: SYSTEM HACKING****(09 Periods)**

System hacking -Password cracking techniques, Types of passwords, Key loggers and other spyware technologies, Escalating privileges, Root kits, How to hide files, Steganography technologies, How to cover your tracks and evidences; Sniffers - Protocols susceptible to sniffing, Active and passive sniffing, ARP poisoning, Ethereal capture and display filters, MAC flooding, DNS spoofing techniques, Sniffing countermeasures; Denial of Service - Types of DoS attacks, How DDoS attacks work, How BOTs/BOTNETs work, Smurf attack, SYN flooding, DoS/DDoS counter measures; Session hijacking - Spoofing vs. hijacking, Types of session hijacking, Sequence prediction, Steps in performing session hijacking, Preventing session hijacking.

**UNIT-V: CRYPTOGRAPHY, NETWORK PROTECTION SYSTEMS****(09 Periods)**

**Cryptography:** Understanding Cryptography basics, Symmetric and asymmetric algorithms, Public key infrastructure, Cryptography attacks.

**Network Protection Systems:** Understanding routers, Firewalls, Honeypots.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Michael T. Simpson, Kent Backman, James E. Corley, *Hands-On Ethical Hacking and Network Defense*, 3<sup>rd</sup> Edition, Cengage Learning, 2017.
2. Kimberly Graves, *CEH: Official Certified Ethical Hacker Review Guide*, Wiley, 2007.

**REFERENCE BOOK:**

1. Michael Gregg, *Certified Ethical Hacker (CEH) Cert guide*, 3<sup>rd</sup> Edition, Pearson, 2019.

**II B. Tech. - II Semester**  
**(19BT51207) AI IN HEALTHCARE**  
(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:** Concepts of Artificial Intelligence (AI) in Healthcare; The Present State and Future of AI in Healthcare Specialties; The Role of Major Corporations in AI in Healthcare; Applications of AI in Healthcare.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the fundamental concepts of AI in Healthcare sector.
- CO2: Understand the applications of AI in Healthcare specialties.
- CO3: Demonstrate AI applications developed by corporate companies.
- CO4: Demonstrate knowledge on future applications of Healthcare using AI.
- CO5: Understand the principles of AI applications through case studies.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO ARTIFICIAL INTELLIGENCE IN HEALTHCARE**  
**(08 Periods)**

Introduction to AI in Healthcare, Benefits and Risks, AI in the health sector, AI versus Human Intelligence, The future of AI in health sector, AI and Neural networks.

**UNIT-II: THE PRESENT STATE AND FUTURE OF AI IN HEALTHCARE SPECIALTIES**  
**(10 Periods)**

**Artificial Intelligence in:** preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

**UNIT-III: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE**  
**(08 Periods)**

IBM Watson, The role of Google and Deep mind in AI in Healthcare, Baidu, Facebook and AI in Healthcare, Microsoft and AI in Healthcare.

**UNIT-IV: FUTURE OF HEALTHCARE IN AI** **(10 Periods)**

Evidence-based medicine, personalized medicine, Connected medicine, Disease and Condition Management, Virtual Assistants, Remote Monitoring, Medication Adherence, Accessible Diagnostic Tests, Smart Implantables, Digital Health and Therapeutics, Education, Incentivized Wellness. Artificial Intelligence, Block chain, Robots, Robot-Assisted Surgery, Exoskeletons, Inpatient Care, Companions, Drones, Smart Places, Smart Homes, Smart Hospitals, Reductionism, Innovation vs. Deliberation.

## **UNIT-V: APPLICATIONS OF AI IN HEALTHCARE**

**(09 Periods)**

**Case Study 1:** AI for Imaging of Diabetic Foot Concerns and Prioritization of Referral for Improvements in Morbidity and Mortality.

**Case Study 2:** Outcomes of a Digitally Delivered, Low-Carbohydrate, Type 2 Diabetes Self-Management.

**Case Study 3:** Delivering a Scalable and Engaging Digital Therapy.

**Case Study 4:** Improving Learning Outcomes for Junior Doctors through the Novel Use of Augmented and Virtual Reality for Epilepsy

**Case Study 5:** Big Data, Big Impact, Big Ethics-Diagnosing Disease Risk from Patient Data.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

### **TEXT BOOKS:**

1. Dr. Parag Mahajan, *Artificial Intelligence in Healthcare*, Med Manthra Publications, First Edition 2019.
2. Arjun Panesar, *Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.

### **REFERENCE BOOKS:**

1. Michael Matheny, SonooThadaneyIsrani, Mahnoor Ahmed, and Danielle Whicher, *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*, National Academy of Medicine Publication, First Edition, 2019.

### **ADDITIONAL LEARNING RESOURCES:**

1. <https://www.udacity.com/course/ai-for-healthcare-nanodegree--nd320>  
(AI for Healthcare).
2. <https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare>  
(Surgical robots, new medicines and better care: 32 examples of AI in healthcare).
3. <https://healthtechmagazine.net/article/2020/02/future-artificial-intelligence-healthcare> (Future of Artificial Intelligence in Healthcare).



**II B. Tech. - II Semester**  
**(19BT51506) BIOINFORMATICS**  
(Open Elective-1)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Biology for Engineers.

**COURSE DESCRIPTION:** Biological Data Acquisition, Databases, Data Processing, Methods of Analysis, Applications of Bio-informatics

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand basic biological data acquisition in bioinformatics.
- CO2: Identify the proper databases for the information search by choosing the biological databases and also submission and retrieval of data from databases.
- CO3: Analyze the results of bioinformatics data using text and sequence-based searching techniques.
- CO4: Analyze the secondary and tertiary structures of proteins by applying different alignment programs
- CO5: Design biological databases and novel drugs by using contextual knowledge on bioinformatics.

**DETAILED SYLLABUS:**

**UNIT-I: BIOLOGICAL DATA ACQUISITION (09 Periods)**

Biological information, Retrieval methods for DNA sequence, protein sequence and protein structure information

**UNIT-II: DATABASES (09 Periods)**

Format and Annotation: Conventions for database indexing and specification of search terms, Common sequence file formats. Annotated sequence databases - primary and secondary sequence databases, protein sequence and structure databases.

**UNIT-III: DATA PROCESSING (09 Periods)**

Data – Access, Retrieval and Submission: Standard search engines; Data retrieval tools – Entrez, DBGET and SRS; Submission of (new and revised) data; Sequence Similarity Searches: Local and global. Distance metrics. Similarity and homology. Scoring matrices, PAM and BLOSUM

**UNIT-IV: METHODS OF ANALYSIS (09 Periods)**

Dynamic programming algorithms, Needleman-Wunsch and Smith-waterman. Heuristic Methods of sequence alignment, FASTA and BLAST; Multiple Sequence Alignment and software tools for pair wise and multiple sequence alignment, CLUSTAL program, Prediction of Tertiary structure of proteins.

**UNIT-V: APPLICATIONS****(09 Periods)**

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis, Genomics, Proteomics, Genome analysis – Genome annotation, DNA Microarray, computer aided drug design (CADD).

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Lesk, A. K., "*Introduction to Bioinformatics*" 4th Edition, Oxford University Press, 2013
2. Dan Gusfield, "*Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology*" Cambridge University Press, 1997.

**REFERENCE BOOKS:**

1. Baldi, P. and Brunak, S., "*Bioinformatics: The Machine Learning Approach*" 2nd Edition, MIT Press. 2001
2. Mount, D.W., "*Bioinformatics Sequence and Genome Analysis*" 2nd Edition, Cold Spring Harbor Laboratory Press, 2004
3. Tindall, J., "*Beginning Perl for Bioinformatics: An introduction to Perl for Biologists*" 1st Edition, O'Reilly Media, 2001

**II B. Tech. – II Semester**  
**(19BT40431) DIGITAL DESIGN WORKSHOP**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** Courses on Switching Theory and Logic Design & Electronic Devices and Circuits.

**COURSE DESCRIPTION:** Design and verification of Digital Circuits, PCB Design of Electronic Circuits.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design and Realize various Digital applications by using ICs for societal needs.
- CO2: Implement Electronic Circuits using Passive and Active elements for specified applications.
- CO3: Analyze performance parameters for PCB designed circuits using a simulation tool.
- CO4: Work independently and in teams to solve problems with effective Communication.

**List of Exercises/List of Experiments:**

**Part-A: Realize the Following in Hardware**

(Minimum **Six** Experiments are to be conducted)

1. Realize gates using NAND & NOR gates.
2. Optimize and Realize a given Boolean Function.
3. Design and Realize BCD to Excess-3 Code Converter.
4. Design and Realize Adder and Subtractor using Multiplexer based on logic gates/ IC74153.
5. Design and Realize a BCD to 7-Segment Decoder using Logic Gates/ ICs.
6. Design and Realize a Hexadecimal to Binary Encoder using IC74148 and IC74157.
7. Design and Realize a Sequence Generator using IC7495.
8. Design and Realize Asynchronous and Synchronous counters using IC7476 (JK-Flip Flop).

**Part-B: PCB Layout Design of Electronic Circuits using TINAPRO/ eSIM-KiCAD/ TinyCAD/ Fritzing Software**

(Minimum **Four** Experiments are to be conducted)

1. RC Filter.
2. Half Wave Precision Rectifier.
3. Zener Regulator.
4. Diode Clamper.
5. Transistor as a Switch.
6. CMOS Inverter.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. John F. Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4<sup>th</sup> Edition, 2008.

**SOFTWARE/Tools used:**

TINAPRO/ eSIM-KiCAD/ TinyCAD PCB Design Tool.

**ADDITIONAL LEARNING RESOURCES:**

1. [http://vlabs.iitb.ac.in/vlabsdev/vlab\\_bootcamp/bootcamp/cool\\_developers/index.html](http://vlabs.iitb.ac.in/vlabsdev/vlab_bootcamp/bootcamp/cool_developers/index.html) - Virtual labs for digital circuits
2. <https://nptel.ac.in/courses/108/108/108108031/>
3. [https://swayam.gov.in/nd2\\_aic20\\_sp59/preview](https://swayam.gov.in/nd2_aic20_sp59/preview)

**II B. Tech. - II Semester**  
**(19BT40432) ELECTRONIC CIRCUIT ANALYSIS AND DESIGN LAB**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PREREQUISITES:** A course on Electronic Devices and Circuits

**COURSE DESCRIPTION:** Design, Simulation and verification of BJT and FET Amplifiers; Multistage Amplifiers; Feedback Amplifiers; Oscillators; Power Amplifiers; Tuned Amplifiers.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design Multistage amplifiers and determine Gain, Bandwidth, Input and Output impedances for specified applications.
- CO2: Design negative feedback amplifiers to determine Gain, Bandwidth, Input and Output Impedances
- CO3: Design Oscillator circuits to generate sustained oscillations
- CO4: Analyze power amplifiers to determine efficiency.
- CO5: Work individually and in groups to solve problems with effective communication.

**List of Exercises/List of Experiments:**

**Part-A: Design and Simulation of the following circuits**

(Minimum **Seven** Experiments are to be conducted):

1. Two Stage RC Coupled Amplifier
2. Cascode Amplifier
3. Common Source MOSFET amplifier
4. Current shunt Feedback Amplifier
5. Voltage Series Feedback Amplifier
6. Wien Bridge Oscillator using Transistors
7. RC Phase Shift Oscillator using Transistor
8. Class A Power Amplifier (Transformer less)
9. Class B Complementary Symmetry Amplifier

**Part-B: Design and verification of the following circuits**

(Minimum **Three** Experiments are to be conducted):

1. Two Stage RC Coupled Amplifier
2. Cascode Amplifier
3. Current shunt Feedback Amplifier
4. Voltage Series Feedback Amplifier
5. LC Oscillator
6. RC Phase Shift Oscillator
7. Class A Power Amplifier

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Md H Rashid , *Introduction to PSpice Using OrCAD for Circuits and Electronics*, PHI, 3<sup>rd</sup> edition, 2012
2. S. Poorna Chandra, B. Sasikala "*Electronics Laboratory Primer*", S. Chand & Company Ltd. 1<sup>st</sup> Reprint Edition 2014

**SOFTWARE/Tools used:**

- PSPICE /Multisim

**II B. Tech. – II Semester**  
**(19BT40433) LINEAR AND DIGITAL IC APPLICATIONS LAB**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A course on Switching Theory and Logic Design

**COURSE DESCRIPTION:** Design and verification of Op-Amp applications; Timers; ADC and DAC; Simulation and synthesis of combinational and sequential circuits; Simulation tools.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design various op-amp applications and timers circuits for societal applications.
- CO2: Implement filters, timers, D-A converter using Op-amps and digital circuits for specified applications
- CO3: Analyze performance parameters for combinational and sequential circuits using any simulation tool.
- CO4: Work independently and in teams to solve problems with effective Communication.

**LIST OF EXPERIMENTS:**

**PART-A: Design the following circuits**

(Minimum **Five** Experiments are to be conducted):

1. RC Phase shift oscillator circuit using Op-Amp 741.
2. Instrumentation Amplifier using Op-Amp 741 with required gain.
3. Differentiator & Integrator using Op-Amp 741.
4. Applications of 555 timer (Monostable / Astable Multivibrator) with given duty cycle and frequency.
5. Active first and second order LPF / HPF filter for a given cut off frequency using Op-amp 741.
6. D-A converter (R-2R ladder) using Op-amp 741 with required voltage levels.

**PART B: Perform simulation and synthesis of the following Digital circuits**

(Minimum **FIVE** experiments are to be conducted using **Verilog HDL**)

1. Arithmetic and Logic Unit using IC 74x181
2. Barrel Shifter using 74x151 multiplexer
3. Floating Point Encoder
4. Dual Priority Encoder
5. Self-Correcting Ring Counter
6. Universal Shift Register using IC 74x194
7. 3-bit Linear Feedback Shift Register

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Ramakanth A. Gayakwad, *Op-Amps & Linear ICs*, PHI, 3rd Edition, 1998.
2. John F. Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4th Edition, 2008.

**SOFTWARE/Tools used:**

XILINX/ Multisim

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.multisim.com/> - Online tool used for linear circuit simulations.
2. [http://vlabs.iitb.ac.in/vlabs-dev/vlab\\_bootcamp/bootcamp/cool\\_developers/index.html](http://vlabs.iitb.ac.in/vlabs-dev/vlab_bootcamp/bootcamp/cool_developers/index.html)



**II B. Tech. - II Semester**  
**(19BT315AC) DESIGN THINKING**  
 (Audit Course)  
 (Common to ECE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| -          | -          | -           | 2 | - | - | - |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Design thinking process, Design thinking phases, empathy tools; Idea generation, visualizing and empathizing; Fidelity for prototypes, prototyping; prototyping for physical products.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze design thinking concepts and principles to perform human centered design process for creative problem solving.
- CO2: Create empathy maps to visualize user attitudes and behavior for gaining insights of customers.
- CO3: Develop innovative products or services for a customer base using ideation techniques.
- CO4: Build prototypes for complex problems using gathered user requirements.
- CO5: Apply design thinking tools techniques to produce good design and relevant products or services for a specific target market.
- CO6: Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO DESIGN THINKING (06 Periods)**

Design Thinking Process: Types of the thinking process, Common methods to change the human thinking process, Design thinking: Definition, Origin of design thinking, Importance of design thinking, Design vs Design thinking, Problem solving, Understanding design thinking and its process model, Design thinking tools.

**UNIT-II: EMPATHIZE (06 Periods)**

Design thinking phases, How to empathize, Role of empathy in design thinking, purpose of empathy maps, Things to be done prior to empathy mapping, Activities during and after the session, Understanding empathy tools : Customer Journey Map, Personas.

**UNIT-III: IDEATION (06 Periods)**

Challenges in idea generation, need for systematic method to connect to user, Visualize, Empathize, and Ideate method, Importance of visualizing and empathizing before ideating, Applying the method, Ideation Tools: How Might We? (HMW), Story board, Brainstorming.

**UNIT-IV: PROTOTYPING****(06 Periods)**

What is a prototype? - Prototyping as a mindset, prototype examples, prototyping for products; Why we prototype? Fidelity for prototypes, Process of prototyping- Minimum Viable prototype

**UNIT-V: TESTING PROTOTYPES****(06 Periods)**

Prototyping for digital products: What's unique for digital, Preparation; Prototyping for physical products: What's unique for physical products, Preparation; Testing prototypes with users.

**Total Periods: 30**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. S.Salivahanan, S.Suresh Kumar, D. Praveen Sam, "*Introduction to Design Thinking*", Tata McGraw Hill, First Edition, 2019.
2. Kathryn McElroy, "*Prototyping for Designers: Developing the best Digital and Physical Products*", O'Reilly, 2017.

**REFERENCE BOOKS:**

1. Michael G. Luchs, Scott Swan, Abbie Griffin, "*Design Thinking - New Product Essentials from PDMA*", Wiley, 2015.
2. Vijay Kumar, "*101 Design Methods: A Structured Approach for Driving Innovation in Your Organization*", 2012.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process>
2. <https://www.ibm.com/design/thinking/page/toolkit>
3. <https://www.interaction-design.org/literature/article/define-and-frame-your-design-challenge-by-creating-your-point-of-view-and-ask-how-might-we>
4. <https://www.culturepartnership.eu/en/article/ten-tools-for-design-thinking>
5. <https://nptel.ac.in/courses/109/104/109104109/>
6. <https://nptel.ac.in/courses/110106124/>

**III B. Tech. – I Semester**  
**(19BT50401) DIGITAL COMMUNICATIONS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Signals and Systems, Analog Communications & Probability and Stochastic Processes.

**COURSE DESCRIPTION:** Digitization techniques - Pulse Code Modulation (PCM), Differential Pulse Code Modulation (DPCM), Delta modulation(DM) and Adaptive Delta Modulation; Digital Baseband and Pass band signal transmission; Detection of Baseband and Pass band signals and error probability; Information Theory - Source and channel coding techniques.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to

- CO1: Analyze the Signal to Noise Ratio in Pulse Code Modulation and Delta modulation systems.
- CO2: Analyze different Base Band, Band Pass Data Transmissions and derive bit error probabilities.
- CO3: Evaluate Channel capacity of Discrete and Continuous Channels.
- CO4: Analyze various error detection and correction codes to enable reliable data transmission.

**DETAILED SYLLABUS:**

**UNIT-I: PULSE DIGITAL MODULATION (11 Periods)**

Pulse Code Modulation (PCM): PCM Generation and Reconstruction, Quantization noise, Non uniform Quantization and Companding, Differential Pulse Code Modulation (DPCM), Delta modulation (DM) and Adaptive Delta Modulation.

**Noise in PCM:** Calculation of Quantization noise, Output Signal Power, Effect of thermal noise in PCM, Output Signal to Noise Ratio(SNR) in PCM.

**Noise in DM:** Quantization Noise in DM, Output signal power, Effect of thermal noise in DM, Output Signal to Noise Ratio in DM; Comparison of PCM and DM systems.

**UNIT-II: BASE BAND DATA TRANSMISSION (07 Periods)**

Elements of Base band Binary PAM Systems, Inter symbol Interference, Eye Pattern, Baseband Shaping, Correlative coding.

**UNIT-III: BAND PASS DATA TRANSMISSION (10 Periods)**

Band Pass Data Transmission: Introduction, Amplitude Shift Keying (ASK); Frequency Shift Keying (FSK); Phase Shift Keying (PSK); Quadrature PSK and M-ary PSK; Differential Phase Shift Keying (DPSK); Probability of error, Optimum filter, Matched filter, Calculation of error Probability of ASK, PSK, FSK.

**UNIT-IV: INFORMATION THEORY****(09 Periods)**

**Information Theory:** Information and entropy, conditional entropy and redundancy, Information rate, Mutual information and its properties. Error Free Communication over Noisy Channel, Channel Capacity of Discrete Memory less Channel, Channel Capacity of Continuous Channel, Hartley Shannon's theorem, bandwidth –S/N trade off.

**Source Coding:** Shannon Fano Coding, Huffman Coding.

**UNIT-V: ERROR CONTROL CODES****(08 Periods)**

**Linear Block Codes:** Matrix description of Linear Block Codes, Error detection and error Correction capabilities of linear block codes. Cyclic Codes.

**Convolution Codes:** Introduction, encoding of convolution codes, time domain approach, transform domain approach. Graphical approach: State, Tree and Trellis diagram. Decoding using Viterbi algorithm.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Herbert Taub. Donald L Schilling, Goutam Sana, *Principles of Communication Systems*, McGraw-Hill, 4<sup>th</sup> Edition, 2012.
2. B.P.Lathi, Zhi Ding *Modern Digital and Analog Communication Systems*, Oxford, 4<sup>th</sup> Edition, 2012.

**REFERENCE BOOKS:**

1. Simon Haykin, *Digital Communications Systems*, Wiley, 2013.
2. K. Sam Shanmugam, *Digital and Analog Communication Systems*, Wiley, 2019.
3. R.P Singh and S.D Sapre, *Communication Systems Analog and Digital*, McGraw Hill Education, 3<sup>rd</sup> Edition, 2017.

**III B. Tech. – I Semester**  
**(19BT50402) DIGITAL SIGNAL PROCESSING**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Signals and Systems.

**COURSE DESCRIPTION:** Continuous and discrete signals and sequences; systems; DFT and FFT algorithms for the analysis of discrete sequences; design and realization of Digital IIR and FIR filters; Programmable DSPs and Architecture of TMS 320C6X.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to

CO1: Analyze discrete-time systems using suitable transforms.

CO2: Apply Discrete and Fast Fourier Transforms to analyze the response of linear systems.

CO3: Design and realize IIR and FIR digital filters by applying transformation and windowing Techniques.

CO4: Demonstrate the Architecture of DSP Processors.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO DIGITAL SIGNAL PROCESSING (10 Periods)**

Review of Discrete-time signals, systems and their classification. Discrete-Time systems described by difference equations.

**Frequency analysis of Discrete Time signals:**

Fourier series for DT periodic signal and power density spectrum, the Fourier transform of DT aperiodic signals and energy density spectrum, convergence of Fourier transforms. Review of Z-transforms, Applications, solution for difference equations of digital filters.

**UNIT-II: DISCRETE AND FAST FOURIER TRANSFORMS (09 Periods)**

DFS representation of periodic sequences, properties of Discrete Fourier Series.

**Discrete Fourier Transforms (DFT):** Properties of DFT, linear filtering methods based on DFT, Relationship of FT to Z Transform, frequency analysis of signals using DFT.

**Fast Fourier transforms (FFT):** Radix-2 Decimation in time (DIT) and Decimation in frequency (DIF) FFT algorithms, Inverse FFT.

**UNIT-III: IIR DIGITAL FILTERS (08 Periods)**

Design of IIR digital filters from analog filters-IIR filter design by approximation of derivatives, impulse invariance and bilinear transformation. Characteristics of commonly used analog filters, Frequency transformations. Structural realization of IIR systems-direct, cascade and parallel form structures, Transposed form.

**UNIT-IV: FIR DIGITAL FILTERS (08 Periods)**

Symmetric and anti-symmetric FIR filters, Design of linear phase FIR digital filters using windowing techniques, Frequency sampling technique, Comparison of IIR and FIR filters. Structural realization of FIR filters-direct, cascade-form structures and linear phase structures.

## **UNIT-V: INTRODUCTION TO DSP PROCESSORS**

**(10 Periods)**

**Introduction to programmable DSPs:** Multiplier and Multiplier Accumulator (MAC), Modified Bus Structures and Memory Access schemes in P-DSPs, Multiple access memory, multiported memory, VLIW Architecture, Pipelining, Special addressing modes, On-Chip Peripherals.

**Architecture of TMS 320C6X:** Introduction, Features of 'C6X Processors, Internal Architecture, CPU, General-Purpose Register Files, Functional Units and Operation, Data Paths, Control Register File.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

### **TEXT BOOKS:**

1. J. G. Proakis and D.G. Manolakis, "*Digital Signal Processing: Principles, Algorithms and Applications*," Prentice Hall, Fourth Edition, 2007.
2. B.Venkataramani, M. Bhaskar, "*Digital Signal Processors – Architecture, Programming and Applications*," TATA McGraw Hill, Second Edition, 2010.

### **REFERENCE BOOKS:**

1. Alan. V. Oppenheim, Ronald.W. Schafer and John.R. Buck, "*Discrete-Time Signal Processing*," Pearson Education, Second Edition, 2006.
2. Emmanuel C. Ifeachor & Barrie. W. Jervis, "*Digital Signal Processing*," Pearson Education / Prentice Hall, Second Edition, 2002.

**III B. Tech. – I Semester**  
**(19BT50403) VLSI DESIGN**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Switching Theory and Logic Design/Digital Logic Design.

**COURSE DESCRIPTION:** Logic Families; CMOS Technology; Stick Diagrams and Layouts; Subsystem design; Programmable Interconnect structures; Memories.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze logic families, steady state and dynamic characteristics of CMOS, to improve performance characteristics of digital ICs.
- CO2: Analyze electrical properties of MOS circuits for VLSI/ULSI chip fabrication.
- CO3: Develop stick diagrams and layouts of CMOS circuits for miniaturization by analyzing gate delays and scaling effects.
- CO4: Design subsystems for High speed digital electronics to compensate tradeoff among area, speed and power requirements.

**DETAILED SYLLABUS:**

**UNIT-I: DIGITAL LOGIC FAMILIES (08 Periods)**

Introduction to logic families, RTL, DTL, Transistor-Transistor logic, Emitter Coupled Logic, I<sup>2</sup>L, CMOS logic, CMOS steady state and dynamic electrical behavior.

**UNIT-II: FABRICATION AND ELECTRICAL PROPERTIES OF MOS (10 Periods)**

Fabrication Process for NMOS and CMOS technology, Basic Electrical Properties of MOS:  $I_{ds} - V_{ds}$  relationships, Second order effects of MOSFETs-Latch up, Hot carrier Effects, channel length modulation, Threshold Voltage  $V_T$ ,  $g_m$ ,  $g_{ds}$  and  $\omega_0$ ; Pass Transistor, NMOS inverter, Pull up to pull down ratio for an NMOS inverter, CMOS Inverter

**UNIT-III: CMOS CIRCUIT DESIGN PROCESS (10 Periods)**

VLSI design flow, MOS layers, stick diagrams, NMOS design style, CMOS design style, lambda based design rules, layouts for inverters, sheet resistance, capacitances of layers, Gate delays, Delay estimation, Scaling, Limitations of Scaling.

**UNIT-IV: SUBSYSTEM DESIGN - I (08 Periods)**

Adders – Transmission based Adder, Carry look-ahead adder, Manchester carry chain adder, Carry Skip Adder, Carry Select Adder; Barrel Shifter, Multipliers – Array Multiplier, Booth Multiplier; ALUs.

**UNIT-V: SUBSYSTEM DESIGN - II****(09 Periods)**

Counters- Synchronous and Asynchronous Counter; High Density Memory Elements - Design Approach, FPGAs, Programmable Interconnect structures - Fusible links, Antifuse via link, UV Erasable, Electrically Erasable; CPLDs, Cell based Design Methodology.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Kamran Eshraghian, Douglas A. Pucknell and sholeh Eshraghian, *Essentials of VLSI Circuits and Systems*, PHI, 2005.
2. Morris Mano, *Digital Design*, Prentice Hall, 3<sup>rd</sup> Edition, 2003.

**REFERENCE BOOKS:**

1. John F.Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4<sup>th</sup> Edition, 2008.
2. John M. Rabaey, *Digital Integrated Circuits: A Design Perspective*, PHI, 2<sup>nd</sup> Edition, 2003.



**III B. Tech. – I Semester**  
**(19BT50404) ELECTRONIC MEASUREMENTS AND INSTRUMENTATION**  
(Professional Elective-1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Electronic Devices and circuits & Network Analysis

**COURSE DESCRIPTION:** Science of Measurement; Construction and principle of operation of Ammeters, Voltmeters, Ohmmeters; Potentiometers; Design of Bridges Signal Analyzers and Oscilloscopes; Transducers; Display Devices and Recorders; Data Acquisition Systems and Telemetry.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Select the suitable measuring instruments to measure parameters like voltage, current, resistance, frequency and time by applying fundamental concepts of measuring
- CO2: Identify the suitable transducers for measurement of non-electrical parameters.
- CO3: Design AC and DC bridges for measurement of resistance, capacitance and Inductance.
- CO4: Analyze the characteristics of the signal using suitable signal analyzer.
- CO5: Apply suitable display devices and recorders based on the application.
- CO6: Demonstrate the knowledge on Data Acquisition System and telemetry concepts.

**DETAILED SYLLABUS:**

**UNIT-I: MEASUREMENTS AND MEASURING SYSTEMS (10 Periods)**

Static characteristics – Accuracy, Precision, Resolution, Sensitivity, measurement Errors; Dynamic Characteristics - Speed of response, fidelity, Lag, Dynamic error and Statistical Analysis; Basic meter movement; Ammeters – Multirange, Universal Shunt, Extending Ranges; DC voltmeters – Multirange, Range extension, Loading, Transistorized Voltmeter; AC voltmeters – Rectifier type, Thermocouple Type; Ohmmeters - Series type and Shunt type; Calibration of DC Instrument & Ohmmeter, Multimeter for Voltage, Current & Resistance measurements.

**UNIT-II: TRANSDUCERS AND BRIDGES (10 Periods)**

**Transducers:** Classification of Transducers; Measurement of Displacement (Resistance, Capacitance, Inductance, LVDT), Force (Strain Gauges), Pressure (Piezoelectric Transducers), Temperature (Resistance Thermometers, Thermocouples, Thermistors); Measurement of Velocity, Acceleration, Vibration, Moisture and pH value.

**Bridges:** Wheatstone bridge, Kelvin Bridge, Practical Kelvin's double bridge, Maxwell's bridge, Hay's bridge, Schering bridge, Wien Bridge, Anderson Bridge, Errors and precautions in using bridges, Q-meter.

### **UNIT-III: SIGNAL ANALYZERS AND OSCILLOSCOPES (12 Periods)**

**Signal Analyzers:** Wave analyzers -Frequency Selective Wave Analyzer, Heterodyne Wave Analyzer, Application of Wave Analyzers, Harmonic Distortion Analyzers, Total Harmonic Distortion; Spectrum Analyzers – Basic Spectrum Analyzer, Spectral Displays, Spectra of Different Spectrum Analyzers.

**Oscilloscopes:** Oscilloscope Block diagram, Cathode Ray Tube, Vertical Deflection System, Delay Line, Horizontal Deflection System - Triggered Sweep, Delayed sweep; CRO Probes, Dual Beam & Trace CROs, Measurement of Amplitude, Frequency and Phase (Lissajous method), Sampling Oscilloscope, Analog Storage Oscilloscope, Digital Storage Oscilloscope.

### **UNIT-IV: DISPLAY DEVICES AND RECORDERS (07 Periods)**

**Display Devices:** Segment Displays – Seven Segment Display, Dot Matrix Display; LCD Display, BCD to 7 Segment Converter, BCD to Dot Matrix Converter.

**Recorders:** Strip Chart Recorder and X-Y Recorder.

### **UNIT-V: DATA ACQUISITION SYSTEMS AND TELEMETRY (06 Periods)**

**Data Acquisition System:** Generalized Data Acquisition System, Single and Multi Channel DAS.

**Telemetry:** General Telemetry System, Types of Telemetry Systems, Land Line Telemetry Systems –Voltage, Current and Position Telemetry Systems; Introduction to Radio Frequency Telemetry.

**Total Periods: 45**

**Topics for self-study are provided in the lesson plan**

#### **TEXT BOOKS:**

1. A.D. Helfrick and W.D. Cooper, *Modern Electronic Instrumentation and Measurement Techniques*, PHI, 5<sup>th</sup> Edition, 2006.
2. A.K. Sawhney, *A Course in Electrical & Electronic Measurement and Instrumentation*, Dhanpat Rai & Company Private Limited, New Delhi, 18<sup>th</sup> Edition, 2007.

#### **REFERENCE BOOKS:**

1. David A. Bell *Electronic Instrumentation & Measurements*, PHI, 2<sup>nd</sup> Edition, 2003.
2. H.S. Kalsi, *Electronic instrumentation*, TMH, 3<sup>rd</sup> Edition, 2015.

#### **ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/108/105/108105153/>
2. [https://swayam.gov.in/nd1\\_noc19\\_ee44/preview](https://swayam.gov.in/nd1_noc19_ee44/preview)

**III B. Tech – I Semester**  
**(19BT50405) FIBER OPTIC COMMUNICATIONS**  
 (Professional Elective-1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Engineering Physics, Electronic Devices & Circuits, Analog Communications and Digital Communications.

**COURSE DESCRIPTION:** Single and Multimode fibers; Fiber materials; Fiber Joints; Optical sources and detectors; Power launching in to the fiber; Optical links; WDM; Introduction to optical networks.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on structure, properties, fabrication and advantages of optical fibers.
- CO2: Analyze attenuation losses and signal distortion in optical fibers.
- CO3: Analyze the performance Optical sources and Detectors
- CO4: Demonstrate Power launching & coupling, splicing and fiber connectors.
- CO5: Analyze Analog optical link to determine Carrier to Noise ratio and Digital optical link to determine Link budgets and power penalties.
- CO6: Demonstrate the concepts of WDM and various components of optical Multiplex and De-multiplexer.

**DETAILED SYLLABUS:**

**UNIT-I: OVERVIEW OF FIBER OPTIC COMMUNICATION (08 periods)**

The General system, Advantages of Optical Fiber Communication, Modes in a planar guide, Phase and group velocity, Goos-Haenchen shift.

Cylindrical Fiber-Modes, Mode Coupling, Step index fibers, Graded index fibers; Single mode fibers, Fiber materials, Fiber Fabrication, Mechanical properties of Fibers.

**UNIT-II: FIBER LOSSES (07 Periods)**

Attenuation, Absorption, Scattering, Bending and Core & Cladding losses. Signal Distortion in Fibers - Pulse Broadening, Intermodal Delay, Intramodal or chromatic dispersion, Overall Fiber Dispersion in Multi Mode and Single Mode Fibers, Polarization-Mode Dispersion, Design optimization of Single-Mode Fibers.

**UNIT-III: OPTICAL SOURCES AND DETECTORS (11 Periods)**

**OPTICAL SOURCES:** Light Emitting Diodes - LED Structures, Light Source Materials, Internal Quantum Efficiency, Modulation capability, Power-Bandwidth product, Laser Diodes- Modes and Threshold Conditions, Laser Diode Rate Equations, External Quantum Efficiencies, Resonant Frequencies.

**OPTICAL DETECTORS:** Physical Principles of Photo Diodes, Photo Detector Noise, Detector Response Time, Avalanche Multiplication Noise, Structures for InGaAs & APDs, Temperature Effect on Avalanche Gain, Comparisons of Photo Detectors.

**UNIT-IV: POWER LAUNCHING AND COUPLING**

**(07 Periods)**

Source to Fiber Power Launching, Lensing Schemes for Coupling Improvement, Fiber-to-Fiber Joints, Fiber alignment and joint loss, LED coupling to single mode fibers, Fiber Splices, Fiber Connectors.

**UNIT-V: OPTICAL LINKS AND COMPONENTS**

**(12 Periods)**

**DIGITAL LINKS:** Point-to-Point Links, budgets, Power penalties.

**ANALOG LINKS:** Overview, Carrier to Noise ratio, Multi-channel Transmission techniques, RF over Fiber, Radio over Fiber Links.

**WDM concepts and Components:** Overview of WDM, Components (Qualitative treatment only) - Passive Optical Couplers, Isolators and circulators, Fiber Grating Filters, Multiplexing and De-multiplexing, Introduction to Optical Networks.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Gerd Keiser, *Optical Fiber Communications*, McGraw Hill International, 4<sup>th</sup> Edition, 2009.
2. John M. Senior, *Optical Fiber Communications principles and practice*, Pearson Edn, 3<sup>rd</sup> Edition, 2010.

**REFERENCE BOOKS:**

1. Max Ming-Kang Liu, *Principles and Applications of optical Communications*, TMH, 2010.
2. S.C.Gupta, *Optical Fiber Communication and its Applications*, PHI, 2011.

**III B. Tech. – I Semester**  
**(19BT50406) FPGA ARCHITECTURES AND APPLICATIONS**  
(Professional Elective-1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Switching Theory and Logic Design & Linear and Digital IC Applications.

**COURSE DESCRIPTION:** Evolution of Programmable Devices, Design with PLDs, FPGA-Organization, Programming, Xilinx-XC2000, XC3000, XC4000 Architectures, Programming Technologies, Anti-Fuse Programmed FPGAs, Design Applications.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Implement Boolean functions using programmable logic devices to develop a digital system.
- CO2: Analyze FPGA's and its programmable technologies to assess the impact of digital functions in the design and development of digital system.
- CO3: Analyze Xilinx & Actel based FPGA architectures, place and route designs for high speed digital Circuits.
- CO4: Develop various sub systems using FPGA for specified applications.

**DETAILED SYLLABUS:**

**UNIT-I: DESIGNING OF PROGRAMMABLE LOGIC DEVICES (09 Periods)**

Introduction, Simple Programmable Logic Devices – Read Only Memories, Programmable Logic Arrays, Programmable Array Logic, Sequential Programmable Logic Devices (22CEV10), Implementation of a serial Adder with Accumulation.

**UNIT-II: FIELD PROGRAMMABLE GATE ARRAYS (08 Periods)**

Introduction to FPGAs, FPGA Programming Technologies, Programmable Logic Block Architectures, Programmable Interconnects, and Programmable I/O blocks in FPGAs, Dedicated Specialized Components of FPGAs, Applications of FPGAs.

**UNIT-III: SRAM Programmable FPGAS (08 Periods)**

Introduction, Programming Technology, Device Architecture, the Xilinx XC2000, XC3000 and XC4000 Architectures.

**UNIT-IV: ANTI-FUSE PROGRAMMED FPGAS (10 Periods)**

Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

**UNIT-V: DESIGN APPLICATIONS****(10 Periods)**

General Design Issues, A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Stephen M. Trimberger, *Field Programmable Gate Array Technology*, Springer International Edition, Eighth Indian Reprint 2015.
2. Charles H. Roth Jr, LizyKurian John, *Digital Systems Design using VHDL*, 3<sup>rd</sup> edition, Cengage Learning, 2017.

**REFERENCE BOOKS:**

1. John V. Oldfield, Richard C. Dorf, *Field Programmable Gate Arrays*, Wiley India, 2008.
2. Pak K. Chan/Samiha Mourad, Wayne Wolf, *Digital Design Using Field Programmable Gate Arrays*, Pearson Low Price Edition, 2009.

**ADDITIONAL LEARNING RESOURCES**

<http://www2.eng.cam.ac.uk/~dmh/4b7/resource/section16.htm>

<https://nptel.ac.in/courses/106103016/21>

<https://nptel.ac.in/courses/106105161/54>

**III B. Tech. - I Semester**  
**(19BT50407) RADAR ENGINEERING**  
 (Professional Elective-1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** Courses on Analog Communications and Digital Communications.

**COURSE DESCRIPTION:** Radar equation; Targets; classification of radars; MTI and pulsed radar; Tracking with radar; radar receivers; Echo signal detection in the presence of noise; Navigational Aids.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Solve problems pertaining to prediction of radar parameters such as range, doppler frequency, signal strength by analyzing the principles of radar systems.
- CO2: Apply appropriate techniques for signal detection, acquisition and tracking of various radar signals.
- CO3: Analyze various types of radar displays, receivers, array antennas. (4)
- CO4: Apply appropriate techniques for detection of radar signals in the presence of noise.
- CO5: Analyze the features of navigational aids such as VOR (VHF Omni Directional Range), ILS (Instrument Landing Systems).

**DETAILED SYLLABUS:**

**UNIT-I: RADAR EQUATION (10 Periods)**

Introduction, Maximum Unambiguous Range, Simple form of Radar Equation, Radar Block Diagram and Operation, Radar Frequencies and Applications, Prediction of Range Performance, Minimum Detectable Signal, Receiver Noise, Modified Radar Range Equation, SNR, Envelope Detector, False Alarm Time and Probability, Integration of Radar Pulses, Radar Cross section of Targets (simple targets - sphere, cone-sphere), Transmitter Power, PRF and Range Ambiguities, System Losses (qualitative treatment), Illustrative Problems.

**UNIT-II: DOPPLER RADAR (11 Periods)**

Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, Illustrative Problems. FM-CW Radar, Range and Doppler Measurement, Block Diagram and Characteristics (Approaching/ Receding Targets), FM-CW altimeter, Multiple Frequency CW Radar, MTI- Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters, MTI Radar Parameters, Limitations to MTI Performance, MTI versus Pulse Doppler radar.

**UNIT-III: RADAR TRACKING****(08 Periods)**

Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse, Tracking in Range, Acquisition and Scanning Patterns, Comparison of Trackers.

**UNIT-IV: RADAR RECEIVERS AND DETECTION CRITERIA****(10 Periods)**

Radar display types, Duplexers – Branch type and Balanced type, Circulators as Duplexers. Introduction to Phased Array Antennas – Basic Concepts, Radiation Pattern, Beam Steering and Beam Width changes.

**Detection of Radar Signals in Noise**–Detection criteria, Neyman-Pearson Observer, Likelihood-Ratio Receiver, Constant false Alarm Rate (CFAR), CFAR Receiver.

**UNIT-V: FUNDAMENTALS OF NAVIGATIONAL AIDS****(06 Periods)**

Introduction and Types of Navigational Aids, VHF Omni Directional Range (VOR) navigation system-salient features-principle of operation- advantages and limitations, ILS (Instrument Landing Systems), Principle of operation.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Merrill I. Skolnik, *Introduction to Radar Systems*, TMH Special Indian Edition, 2<sup>nd</sup> Edition, Reprint 2017.
2. G S N Raju, *Radar Engineering and Fundamentals of Navigational Aids*, I.K. International Pvt. Ltd, 1<sup>st</sup> Edition, 2010.

**REFERENCE BOOKS:**

1. Merrill I. Skolnik, *Introduction to Radar Systems*, TMH, 3<sup>rd</sup> Edition, Reprint 2017.
2. Byron Edde, *Radar Principles, Technology, Applications*, Pearson Education, 2004.



**III B. Tech. – I Semester**  
**(19BT4HS01) BANKING AND INSURANCE**  
 (Open Elective-2)  
 (Common to EEE, ECE and EIE)

|            |            |             |   |   |   |   |
|------------|------------|-------------|---|---|---|---|
| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Scope, Objectives and Elements of cost Accounting; Cost Sheet and Tender quotations; Variance Analysis: Material variances, Labor variances; Meaning and Scope, Liquidity, Profitability Ratios: concept of Risk and Return on Investment.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge in concepts and functions of Banking and Insurance, RBI, bank and customer relationship, types of accounts, types of loans and advances, types of insurance and risk.
- CO2: Develop skills to provide solutions in electronic payment system, business models and insurance claims.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO BANKING (09 Periods)**

Meaning - Importance of banking - Functions of banking - **Reserve Bank of India:** Functions – Role of RBI in sustainable development.

**UNIT-II: BANK-CUSTOMER RELATIONSHIP (09 Periods)**

Debtor-creditor relationship, deposit products or services, payment and collection of cheques. Accounts – Types of accounts, procedure for opening and closing an account - Loans and Advances- Principles of lending and types of loans.

**UNIT-III: ELECTRONIC PAYMENT SYSTEM & BUSINESS MODELS (09 Periods)**

Introduction to Online Banking - types of e-payment system, e-cash, NEFT, RTGS, Credit cards, Debit cards and Electronic Wallet - Business models: B2B, B2C, C2C and B2G.

**UNIT-IV: INTRODUCTION TO RISK AND INSURANCE (09 Periods)**

Concept of risk, risk Vs uncertainty. **Insurance:** Definition, Insurance as risk mitigation mechanism, elements of insurance.

**UNIT-V: INSURANCE OVERVIEW (09 Periods)**

Principles and Functions of Insurance - Types of Insurance - LIC and GIC - IRDA - Insurance Players in India.

**Total Periods: 45**

**Topics for self-study are provided in the lesson plan**

**TEXT BOOKS:**

1. RanganadhaChary,A.V. and Paul, R.R., *Banking and Financial system*, Kalyani Publisher, New Delhi, 3<sup>rd</sup> edition, 2016.
2. Sharma,R.K., Shashi K. Gupta and Jagwant Singh, *Banking and Insurance*, Kalyani Publishers, New Delhi, 17<sup>th</sup> edition, 2014.

**REFERENCES BOOKS:**

1. *Indian Institute of Banking & Finance, Digital Banking*, Taxmann Publications Pvt. Ltd., 2016
2. Jyotsna Sethi and Nishwan Bhatia, *Elements of Banking and Insurance*, PHI Learning Pvt. Ltd., 2<sup>nd</sup> edition, 2012.

**III B. Tech. – I Semester**  
**(19BT4HS03) COST ACCOUNTING AND FINANCIAL MANAGEMENT**  
 (Open Elective-2)  
 (Common to EEE, ECE and EIE)

|            |            |             |   |   |   |   |
|------------|------------|-------------|---|---|---|---|
| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Scope, Objectives and Elements of cost Accounting; Cost Sheet and Tender quotations; Variance Analysis: Material variances, Labor variances; Meaning and Scope, Liquidity, Profitability Ratios: concept of Risk and Return on Investment.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge in Costing, Material, Labor, Overheads, Cost control, risk and return, security analysis and portfolio management.
- CO2: Design solutions for effective investment decisions, cost analysis, tenders, quotations, variance analysis, ratio analysis and capital budgeting techniques.

**DETAILED SYLLABUS:**

**UNIT-I: COST ACCOUNTING (09 Periods)**

Meaning of Cost and Cost Accounting, Objectives, Scope, Advantages and disadvantages – Cost Accounting Vs Management Accounting – Elements of Costing – Installation of costing system – Material Control, Labour Control, Overhead Control.

**UNIT-II: COST SHEET & PREPARATION OF COST SHEET (09 Periods)**

Analysis of Cost – Importance of Costing while pricing the products - Preparation of cost sheet, estimate, tender and quotation (Simple problems).

**UNIT-III: STANDARD COSTING & VARIANCE ANALYSIS (09 Periods)**

Introduction to Standard Costing & Variances – Variance Analysis: Material variances, Labour variances (Simple Problems).

**UNIT-IV: FINANCIAL MANAGEMENT& RATIO ANALYSIS (09 Periods)**

Meaning, Objectives - Nature and Scope, Importance of FM – **Ratio Analysis:** Solvency ratios, Liquidity ratios, Profitability ratios, Financial Statement Analysis through ratios (Simple Problems).

**UNIT-V: INTRODUCTION TO INVESTMENT (09 Periods)**

Investment – Meaning and Definition- concept of risk and returns-Investment Alternatives- Capital Budgeting techniques – Security Analysis and Portfolio Management (Basic concepts).

**Total periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. S.P. Jain and K.L. Narang: *Cost Accounting*, Kalyani Publishers, Ludhiana, 10<sup>th</sup> edition, 2016.
2. I.M. Pandey, *Financial Management*, Vikas Publishing House Pvt. Ltd., 14<sup>th</sup> edition, 2016.

**REFERENCE BOOKS:**

1. The Institute of Company Secretaries of India, *Cost and Management Study Material*, New Delhi.
2. CA SaravanaPrasath, *Cost Accounting and Financial management*, Wolters Kluwer India Pvt. Ltd., New Delhi, 2018 edition, 2018.

**III B. Tech. – I Semester**  
**(19BT4HS05) GENDER AND ENVIRONMENT**

(Open Elective-2)

(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Gender and the environment relationship, Gendered Roles in the family & community, Gender and sustainable development, Gender in environmental justice, Gender & environmental security.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the knowledge of gender & environment connections, key issues and topics within global environmental politics in environmental decision-making.
- CO2: Comprehend the concepts of gender and sustainable development through debates, and policy documents.
- CO3: Analyze the concept of environmental security and justice by identifying the sources of insecurity.

**DETAILED SYLLABUS:**

**UNIT-I: GENDER AND ENVIRONMENT RELATIONSHIP (09 Periods)**

Introduction–Gender and Environment–Development of gender roles–Society, gender & environment – Understanding environmental politics – Gender-environment connections–Eco-feminism – Cultural eco-feminism–Social eco-feminism – Feminist political ecology.

**UNIT-II: GENDERED ROLES IN THE FAMILY & COMMUNITY (09 Periods)**

Organization of the household – Domestic division of labour – Food: growing, harvesting, shopping, preparing, and cooking.

Gender & Power- Planning – Politics – NGO – Gendering of environmental protest – Environmental decision-making.

**UNIT-III: GENDER AND SUSTAINABLE DEVELOPMENT (09 Periods)**

Concept of sustainability & its achievement – Concept of sustainable development – Ecological Modernization – Gender & sustainability debates – Gender & sustainable development debates – Gender in policy documents – Gender, poverty & equity in sustainable development.

**UNIT-IV: GENDER IN ENVIRONMENTAL JUSTICE (09 Periods)**

Normative Concerns ( Fairness, Inequality & Justice) – Making sense of Environmental justice – Ecological debt, Transnational harm, & human rights – Ecological justice – Gender & Environmental Justice – Gender, Vulnerability & risk – Women in

environmental justice movements – Knowledge & participation – Gender, sustainability & justice as guiding concepts.

**UNIT-V: GENDER AND ENVIRONMENTAL SECURITY (09 Periods)**

Connections between security & the environment – **Gender, environment & security:** Sustainability as security - poverty & insecurity – Insecurity as injustice – Competing ways of thinking security – Reflecting on sources of insecurity – **Case Study** – Food Security -**Case Study** – The impacts of natural disasters.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Nicole Detraz, *Gender and the Environment*, Polity Press, Cambridge, UK, 2017.
2. Susan Buckingham- Hatfield, *Gender and Environment*, Routledge, London, 2000.

**REFERENCE BOOKS:**

1. Promillakapur (ed). (2000). “*Empowering Indian Women*” Publication Division, Government of India, New Delhi.
2. Ronnie Vernooy, (Ed). (2006). “*Social and gender Analysis Natural Resource Management: Learning studies and lessons from Aisa*” Sage, New Delhi.
3. Swarup, Hemlata and Rajput, Pam. (2000). *Gender Dimensions of Environmental and Development Debate: The Indian Experience*” In SturatS. Nagel, (ed). “India ”s Development and Public Policy”, Ashgate, Burlington.

**III B. Tech. – I Semester**  
**(19BT4HS07) INDIAN ECONOMY**  
(Open Elective-2)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction; Time Value of Money; Elementary Economic Analysis; Value Analysis/Value Engineering; Economic Planning.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the basic concepts of economics, economic analysis, economic planning and strate.
- CO2: Demonstrate knowledge in capital budgeting, evaluation of engineering projects, depreciation policy and familiarize with the concepts of value analysis vs value engineering.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION (09 Periods)**

Economics - Flow in an Economy, Law of Supply and Demand; Micro and Macro Economics; Relationship between Science, Engineering, Technology and Economic Development; Concept of Engineering Economics-Types of Efficiency, Definition and Scope of Engineering Economics.

**UNIT-II: ELEMENTARY ECONOMIC ANALYSIS (09 Periods)**

Economic Analysis – Meaning, Significance, Simple Economic Analysis; Material Selection for a Product, Substitution of Raw Material; Design Selection for a Product; Material Selection-Process Planning, Process Modification.

**UNIT-III: ECONOMIC PLANNING (09 Periods)**

Introduction - Need For Planning in India, Five year plans(1951-2012), NITI Aayog (from 2014 onwards); Inclusive Growth-Meaning, Significance, Need for inclusive growth in India, Strategy for more inclusive growth, Challenges and Prospects; Employment and Inclusive Growth in India, Role of engineers in sustaining inclusive growth.

**UNIT-IV: TIME VALUE OF MONEY (12 Periods)**

Concepts and Application; Capital Budgeting-Traditional and Modern Methods; Simple and Compound Interest, Cash Flow Diagram, Principle of Economic Equivalence; Evaluation of Engineering Projects – Present Worth Method, Future Worth Method, Annual Worth Method, Internal Rate of Return Method, Cost-benefit Analysis in Public Projects; Depreciation Policy-Depreciation of Capital Assets, Causes of Depreciation, Straight Line Method and Declining Balance Method.

**UNIT-V: VALUE ANALYSIS/VALUE ENGINEERING****(06 Periods)**

Introduction - Value Analysis, Value Engineering, Functions, Aims; Value Analysis vs Value Engineering; Value Engineering Procedure- Advantages, Application Areas.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Panneerselvam. R., *Engineering Economics*, PHI Learning Private Limited, New Delhi, 2nd edition, 2013.
2. Jain. T. R., V. K. Ohri, O. P. Khanna. *Economics for Engineers*. VK Publication, 1st edition, 2015.

**REFERENCE BOOKS:**

1. DuttRudar and Sundhram K. P. M., *Indian Economy*, S. Chand, New Delhi, 62<sup>nd</sup> revised edition, 2010.
2. Misra. S. K. and V. K. Puri., *Indian Economy: Its Development Experience*, Himalaya Publishing House, Mumbai, 32<sup>nd</sup> edition, 2010.



**III B. Tech. – I Semester**  
**(19BT4HS09) LIFE SKILLS**  
 (Open Elective-2)  
 (Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Positive attitude; Self-discovery-Interpersonal relationships; Cross-cultural communication; Core thinking-Problem solving and Decision making; Business presentations and Public speaking.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Gain knowledge in strategies involved in developing positive attitude, process of knowing oneself and managing effective interpersonal relationships.
- CO2: Analyse problem solving strategies in Decision Making and SWOT analysis.
- CO3: Communicate effectively with Engineering Community and Society by demonstrating presentation skills in professional arena.

**DETAILED SYLLABUS:**

**UNIT-I: POSITIVE ATTITUDE (09 Periods)**

Introduction, Features of attitudes, Formation of attitudes, Ways of changing attitude in a person, Attitude in a work place, Developing positive attitude, Obstacles in developing positive attitude, Measuring attitude.

**UNIT-II: SELF DISCOVERY AND INTERPERSONAL RELATIONSHIPS (09 Periods)**

Importance of knowing yourself, Process of knowing yourself, SWOT Analysis, Elements of attitude in interpersonal relationships, Methods to deal with different types of interpersonal relationship skills.

**UNIT-III: CROSS-CULTURAL COMMUNICATION (09 Periods)**

Different Communication Styles, Cultural variables, communication sensitivity and variables of national culture, Individual Cultural Variables, Cross-cultural Communication Strategies, Potential hot spots in cross-cultural communication, Cross-cultural communication – Basic Tips.

**UNIT-IV: CORE THINKING, PROBLEM SOLVING AND DECISION MAKING**

**(09 Periods)**

Process of developing core thinking skills, Categories of thinking: Critical & Creative, Understanding problem solving, Cause of problems, Stages of problem solving, Methods of problem solving, Types of decision making.

**UNIT-V: BUSINESS PRESENTATIONS AND PUBLIC SPEAKING (09 Periods)**

Business presentations and speeches, structuring the material, Types of delivery, Guidelines for delivery, Effective sales presentation, Controlling nervousness and stage fright.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Dr. K. Alex (2018) *Soft Skills*, S. Chand and Company Limited, New Delhi.
2. Manmohan Joshi (2017) *Soft Skills*, bookboon.com, Bangalore.

**REFERENCE BOOKS:**

1. Meenakshi Raman and Prakash Singh (2013), *Business Communication*, Oxford University Press, New Delhi.
2. Jeff Butterfield (2011) *Soft Skills for Everyone*, Cengage Learning India Private Limited, Delhi.

**III B. Tech. – I Semester**  
**(19BT4HS11) PROFESSIONAL ETHICS**  
(Open Elective-2)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Engineering Ethics; Professional Ideals and Virtues; Engineering as Social Experimentation; Responsibilities and Rights; Global Issues.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Demonstrate knowledge in Engineering Ethics, Responsibilities and Rights.

CO2: Analyze the concepts of Engineering in Social Experimentation and Global Issues.

CO3: Apply the nuances of professional ideals at work place and in social context.

**DETAILED SYLLABUS:**

**UNIT-I: ENGINEERING ETHICS**

**(09 Periods)**

Scope and aim of engineering ethics, Senses of engineering ethics, Variety of moral issues, Types of inquiry, Moral dilemmas, Moral autonomy-Kohlberg's theory, Gilligan's theory, Consensus and controversy.

**UNIT-II: PROFESSIONAL IDEALS AND VIRTUES**

**(08 Periods)**

Theories about virtues, Professions, Professionalism, Characteristics, Expectations, Professional responsibility, Integrity, Self-respect, Sense of responsibility, Self-interest, Customs and religion, Self-interest and ethical egoism, Customs and ethical relativism, Religion and divine command ethics, Use of ethical theories, Resolving moral dilemmas and moral leadership.

**UNIT-III: ENGINEERING AS SOCIAL EXPERIMENTATION**

**(10 Periods)**

Engineering as experimentation, Similarities to standard experiments, Learning from the past and knowledge gained, Engineers as responsible experimenters, Conscientiousness, Moral autonomy and accountability, The challenger case, Codes of ethics and limitations, Industrial standards, Problems with the law of engineering.

**UNIT-IV: RESPONSIBILITIES AND RIGHTS**

**(09 Periods)**

Collegiality and loyalty, Respect for authority, Collective bargaining, Confidentiality, Conflict of interests, Occupational crime, Rights of engineers, Professional rights, Whistle-blowing, The BART case, Employee rights and discrimination.

**UNIT-V: GLOBAL ISSUES****(09 Periods)**

Multinational corporations, Professional ethics, Environmental ethics, Computer ethics, Engineers as consultants, Witnesses, Advisors and Leaders, Engineers as Managers, Managerial ethics applied to Engineering Profession, moral leadership.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Mike W. Martin and Roland Schinzinger, *Ethics in Engineering*, Tata McGraw-Hill, 3<sup>rd</sup> edition, 2007.
2. Govindarajan, M., Nata Govindarajan, M., Natarajan, S. and Senthil Kumar, V. S., *Engineering Ethics*, Prentice Hall of India, 2004.

**REFERENCE BOOKS:**

1. S. Kannan and K. Srilakshmi, *Human Values and Professional Ethics*, Taxmann Allied Services Pvt Ltd., 2009.
2. Edmund G. Seebauer and Robert L. Barry, *Fundamental of Ethics for Scientists and Engineers*, Oxford University Press, 2001.

**III B. Tech. – I Semester**  
**(19BT4HS13) INDIAN TRADITION AND CULTURE**  
 (Open Elective-2)  
 (Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Basic traits of Indian Culture; Humanistic Reforms under Jainism and Buddhism; Culture in the medieval period; Socio Religious reforms in Indian Culture; Reform movements for harmonious relations.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate the knowledge in Vedic culture, cultural aspects of Buddhism, Jainism and cultural conditions in the medieval period.
- CO2: Understand the impact of socio religious reforms and movements on Indian tradition and culture to improve harmonious relations within society.

**DETAILED SYLLABUS:**

**UNIT-I: BASIC TRAITS OF INDIAN CULTURE (09 Periods)**

Meaning and definition and various interpretations of culture, Culture and its features. The Vedic and Upanishadic culture and society. Human aspirations and values in these societies. Chaturvidha purushardhas, Chaturashrma and Chaturvarna theory.

**UNIT-II: HUMANISTIC REFORMS UNDER JAINISM AND BUDDHISM (09 Periods)**

Salient features of Jainism - contributions of Jainism to Indian culture. Contributions of Achaarya and Mahaapragya. Buddhism as a humanistic culture. The four noble truths of Buddhism. Contributions of Buddhism to Indian culture.

**UNIT-III: CULTURE IN THE MEDIEVAL PERIOD (09 Periods)**

Unifications of India under Mouryas and Guptas and their cultural achievements. Cultural conditions under satavahanas. Contributions to pallavas and cholas to art and cultural achievements of vijayanagara rulers.

**UNIT-IV: SOCIO RELIGIOUS REFORMS IN INDIAN CULTURE (09 Periods)**

Western impact on India, Introduction of western education, social and cultural awakening and social reform movements of Rajaramohan Roy - Dayanandha Saraswathi- Anne Besant (theosophical society).

**UNIT-V: REFORM MOVEMENTS FOR HARMONIOUS RELATIONS (09 Periods)**

Vivekananda, Eswarchandravidyasagar and Veeresalingam - emancipation of women and struggle against caste. Rise of Indian nationalism. Mahatma Gandhi- Nonviolence and satyagraha and eradication of untouchability.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOK:**

1. Valluru Prabhakaraiah, *Indian Heritage and Culture*, Neelkamal Publications Pvt. Ltd. Delhi, First Edition, 2015.

**REFERENCE BOOKS:**

1. L. P. Sharma, *History of Ancient India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
2. L. P. Sharma, *History of Medieval India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
3. L. P. Sharma, *History of Modern India*, Konark Publishers, Pvt. Ltd. New Delhi, 2010.
4. The Cultural Heritage of India Vol-I, II, III, IV, V, The Ramakrishna Mission Institute of Culture, Calcutta.

**III B. Tech. – I Semester**  
**(19BT40106) DISASTER MITIGATION AND MANAGEMENT**  
(Open Elective-2)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Disasters; Earthquakes; Floods; Cyclones; Droughts; Landslides; Disaster management.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the vulnerability of an area to natural and man-made disasters/hazards as per the guidelines to solve complex problems using appropriate techniques ensuring safety, environment and sustainability.
- CO2: Propose appropriate mitigation strategies for earthquake and tsunami impacts as per code of practice using suitable techniques ensuring safety, environment and sustainability besides communicating effectively in graphical form.
- CO3: Analyze the causes and impacts of floods, cyclones and droughts using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability besides communicating effectively in graphical form.
- CO4: Analyze the causes and impacts of landslides using appropriate tools and techniques and suggest mitigation measures ensuring safety, environment and sustainability.
- CO5: Design disaster management strategies to solve pre, during and post disaster problems using appropriate tools and techniques following the relevant guidelines and latest developments ensuring safety, environment and sustainability besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT-I: DISASTERS (09 Periods)**  
Types of disasters - Natural disasters; Impact of disasters on environment, infrastructure and development; Concepts of hazards and vulnerability analysis, Hazard Assessment, Guidelines for hazard assessment and vulnerability analysis, Basic principles and elements of disaster mitigation.

**UNIT-II: EARTHQUAKES (09 Periods)**  
Introduction to earthquake, Intensity scale (MSK-64), Seismic zones and activity in India, Action plan for earthquake disaster preparedness, Elements at risk, Recovery and rehabilitation after earthquake, Concepts of Earthquake resistant design and construction of buildings; Tsunami – Onset, Types and causes, Warning, Elements at risk, Typical effects, Specific preparedness and mitigation strategies, Case studies.

**UNIT-III: FLOODS, CYCLONES AND DROUGHTS (11 Periods)**

**Floods and Cyclones:** Onset, Types, Causes, Warnings, Elements at risk, Typical effects, Indian floods and cyclones, Hazard zones, Potential for reducing hazards, Mitigation strategies and community based mitigation, Case studies.

**Droughts:** Onset, Types and warning; Causes, Impact, Early warning and response mechanisms, Mitigation strategies, Droughts in India, Case studies.

**UNIT-IV: LANDSLIDES (08 Periods)**

Onset, Types and warning; Causes, Elements at risk, Indian landslides, Hazards zones, Typical effects, Mitigation strategies and community based mitigation, Case studies.

**UNIT-V: DISASTER MANAGEMENT (08 Periods)**

Disaster management organization and methodology, Disaster management cycle, Disaster management in India – Typical cases and Cost-benefit analysis, Disaster management programs implemented by NGOs and Government of India, Usage of GIS and Remote sensing techniques in disaster management, Leadership and Coordination in Disaster management, Emerging trends in disaster management.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. V. K. Sharma, *Disaster Management*, Medtech Publishing, 2<sup>nd</sup> Edition, 2013.
2. Anand S. Arya, Anup Karanth, and Ankush Agarwal, *Hazards, Disasters and Your Community: A Primer for Parliamentarians*, GOI-UNDP Disaster Risk Management Programme, Government of India, National Disaster Management Division, Ministry of Home Affairs, New Delhi, Version 1.0, 2005.

**REFERENCE BOOKS:**

1. Donald Hyndman and David Hyndman, *Natural Hazards and Disasters*, Cengage Learning, 3<sup>rd</sup> Edition, 2011.
2. *Disaster Management in India*, A Status Report, Ministry of Home Affairs, Govt. of India, May 2011.
3. Rajendra Kumar Bhandari, *Disaster Education and Management: A Joyride for Students, Teachers, and Disaster Managers*, Springer India, 2014.
4. R. B. Singh, *Natural Hazards and Disaster Management*, Rawat Publications, 2009.

**ADDITIONAL LEARNING RESOURCES:**

1. Tushar Bhattacharya, *Disaster Science and Management*, McGraw Hill, 2014.



**III B. Tech. – I Semester**  
**(19BT40107) SUSTAINABLE ENGINEERING**  
(Open Elective-2)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Principles of sustainability; Sustainability metrics and assessment tools; Sustainable engineering practices; Sustainable engineering applications; Sustainable urbanization and industrialization.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the principles of sustainability to solve complex environmental problems following relevant standards/protocols considering society, health, safety and environment.
- CO2: Analyze sustainability metrics and assessment tools to solve complex environmental problems following relevant standards and emerging trends considering society, health, safety, environment and economics besides communicating effectively in graphical form.
- CO3: Analyze sustainable engineering practices to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.
- CO4: Design sustainable engineering applications to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.
- CO5: Analyze sustainable urbanization and industrialization principles to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT-I: PRINCIPLES OF SUSTAINABILITY (09 Periods)**

Emerging challenges, Sustainability and sustainable engineering; Environmental concerns; Social, economic and legal issues; Availability and depletion of natural resources, Disaster resiliency; Multilateral environmental agreements – Basel convention, Clean development mechanism (CDM), Montreal and Kyoto protocols.

**UNIT-II: SUSTAINABILITY METRICS AND ASSESSMENT TOOLS (09 Periods)**

Sustainability indicators, metrics and assessment tools, Material flow analysis and material budget, Carbon footprint analysis, Life cycle assessment, Streamlined life-cycle assessment (SLCA), Economic input output-life cycle analysis, Environmental health risk assessment, Other emerging assessment tools.

**UNIT-III: SUSTAINABLE ENGINEERING PRACTICES****(09 Periods)**

Sustainable energy engineering, Sustainable waste management, Green and sustainable buildings and infrastructure, Sustainable civil infrastructure, Sustainable remediation of contaminated sites, Climate geoengineering.

**UNIT-IV: SUSTAINABLE ENGINEERING APPLICATIONS****(09 Periods)**

Environmental and chemical engineering projects, Materials engineering projects, Infrastructure engineering projects – Background, Methodology, Goal and Scope, Study area, Technical design, Environmental sustainability, Life cycle assessment, Economic sustainability, Social sustainability, Rating systems – ENVISION, LEED, GRIHA, IGBC; Conclusions.

**UNIT-V: SUSTAINABLE URBANIZATION AND INDUSTRIALIZATION (09 Periods)**

Sustainable urbanization and industrialization, United Nations sustainable development goals – Right to education, Poverty eradication, Social and technological changes; Industrial Processes - Material selection, Energy efficiency, Pollution prevention and control techniques, Industrial Ecology, Industrial symbiosis.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Reddy, K.R., Cameselle, C., and Adams, J.A., *Sustainable Engineering: Drivers, Metrics, Tools, and Applications*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2019, 544p (ISBN: 978-1-119-49393-8).
2. Allen, D. T. and Shonnard, D. R., *Sustainability Engineering: Concepts, Design and Case Studies*, Pearson Education, 1<sup>st</sup> Edition, 2012.

**REFERENCE BOOKS:**

1. Bradley, A.S; Adebayo, A.O., Maria, P., *Engineering Applications in Sustainable Design and Development*, Cengage Learning, 1<sup>st</sup> Edition, 2016.
2. Purohit, S. S., *Green Technology: An Approach for Sustainable Environment*, Agrobios Publication, 1<sup>st</sup> Edition, 2016.
3. *Energy Conservation Building Code (ECBC) 2007*, Bureau of Energy Efficiency, Govt. of India, New Delhi.
4. Twidell, J. W. and Weir, A. D., *Renewable Energy Resources*, Routledge, Taylor & Francis Group, 3<sup>rd</sup> Edition, 2015.

**ADDITIONAL LEARNING RESOURCES:**

1. Daniel A. Vallero and Chris Brasier, *Sustainable Design: The Science of Sustainability and Green Engineering*, Wiley-Blackwell, 1<sup>st</sup> Edition, 2008.
2. Jorge A. Vanegas, *Sustainable Engineering Practice: An Introduction*, Committee on Sustainability, American Society of Civil Engineers, <https://doi.org/10.1061/9780784407509>, 2004.
3. Mackenthun, K.M., *Basic Concepts in Environmental Management*, CRC Press, Taylor & Francis Group, 1<sup>st</sup> Edition, 1999.
4. *Environment Impact Assessment Guidelines*, Notification of Government of India, 2006.

**III B. Tech. – I Semester**  
**(19BT40108) CONTRACT LAWS AND REGULATIONS**  
 (Open Elective-2)  
 (Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Construction contracts; Tenders; Arbitration; Legal requirements; Labour regulations.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Develop construction contracts to solve complex contract related problems by following laws and regulations considering project schedule, cost, quality and risk.
- CO2: Prepare tenders as per the specifications by following latest developments, laws and regulations to solve complex tender problems considering project schedule, cost, quality and risk.
- CO3: Analyze arbitration problems to address the contract disputes following the laws and regulations in the context of society.
- CO4: Analyze legal issues pertaining to contracts and tenders considering society.
- CO5: Analyze labour regulations to address labour safety issues.

**DETAILED SYLLABUS:**

**UNIT-I: CONSTRUCTION CONTRACTS (09 Periods)**

Indian contracts act, Elements of contracts, Types of contracts, Features, Suitability, Design of contract documents, International contract document and laws, Standard contract document, Law of torts.

**UNIT-II: TENDERS (09 Periods)**

Prequalification, Bidding, Accepting; Evaluation of tender from technical, contractual and financial points of view; Two cover system, Preparation of the documentation, Contract formation and interpretation, Potential contractual problems, Price variation clause, Comparison of actions and laws, Subject matter, Violations, Latest developments in tendering.

**UNIT-III: ARBITRATION (09 Periods)**

Arbitration, Comparison of actions and laws, Agreements, Appointment of arbitrators, Conditions of arbitration, Powers and duties of arbitrator, Rules of evidence, Enforcement of award, Arbitration disputes, Dispute review board.

**UNIT-IV: LEGAL REQUIREMENTS (09 Periods)**

Legal requirements for planning, Property law, Agency law, Tax laws – Income tax, Sales tax, Excise and custom duties, Local government approval, Statutory regulations, Insurance and bonding, Laws governing purchase and sale, Use of urban and rural land, Land revenue codes, EMD, Security deposits, Liquidated damages.

**UNIT-V: LABOUR REGULATIONS****(09 Periods)**

Social security, Welfare legislation; Laws relating to wages, bonus and industrial disputes; Labour administration, Insurance and safety regulations, Workmen's compensation act, Maternity benefit act, Child labour act, Other labour laws.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Subba Rao, G.C.V., *Law of Contracts I & II*, S. Gogia & Co., 11<sup>th</sup> Edition, 2011.
2. Jimmie Hinze, *Construction Contracts*, McGraw Hill, 3<sup>rd</sup> Edition, 2011.

**REFERENCES BOOKS:**

1. Kishore Gajaria, *GT Gajaria's Law Relating to Building and Engineering Contracts in India*, Lexis Nexis Butterworths India, 4<sup>th</sup> Edition, 2000.
2. Patil, B. S., *Civil Engineering Contracts and Estimates*, University Press (India) Private Ltd., 4<sup>th</sup> Edition, 2015.
3. Joseph T. Bockrath, *Contracts and the Legal Environment for Engineers and Architects*, McGraw Hill Education, 7<sup>th</sup> Edition, 2010.
4. Akhileshwar Pathak, *Contract Law*, Oxford University Press, 2011.

**ADDITIONAL LEARNING RESOURCES:**

1. P.C. Markanda, Naresh Markanda, Rajesh Markanda, *Building and Engineering Contracts- Law and Practice*, Vol-I and II, 5<sup>th</sup> Edition, LexisNexis Publication.

**III B. Tech. – I Semester**  
**(19BT40306) GLOBAL STRATEGY AND TECHNOLOGY**  
 (Open Elective-2)  
 (Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:** Introduction to strategic management; Strategic management process; Principles of good strategy; Globalization strategies; Research and Development strategies; Technology Management and Transfer; Elements of Transfer Process; Corporate Governance in the Indian scenario.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate the knowledge on strategic management, its approaches, and tools through ethical decision making.
- CO2: Analyze the globalization challenges for scrupulous selection of globalization strategies.
- CO3: Apply the R&D strategies and trends to enhance the technological breakthroughs for new products and applications.
- CO4: Demonstrate the knowledge on technology management and transfer that strengthen the economy and accelerate the application of technology and resources.
- CO5: Analyze the challenges of corporate governance in Indian scenario for the effective development of value oriented organizations.

**DETAILED SYLLABUS:**

**UNIT-I: STRATEGIC MANAGEMENT (09 Periods)**

Introduction, Classes of decisions, Levels of strategy, Core competence, Strategic intent and stretch, Approaches to strategy making, Roles of different strategists, Strategic management-Process, Benefits, Limitations; Ethics in strategic decision making, Principles of good strategy, Strategic Management in India; Common managerial strategy formulation tools.

**UNIT-II: GLOBALIZATION (09 Periods)**

Definition, Stages, Essential conditions for globalization, Globalization strategies, Competitive advantage of Nations and regions, Factors affecting Globalization, Globalization of Indian business.

**UNIT-III: RESEARCH & DEVELOPMENT STRATEGIES (09 Periods)**

Concept, Evolution of R and D Management, R and D as a business, R and D as competitive advantage, Elements of R and D strategies, Integration of R and D, Selection and implementation of R and D strategies, R and D trends and challenges.

**UNIT-IV: TECHNOLOGY MANAGEMENT AND TRANSFER****(09 Periods)**

**Technology Management:** Introduction, Technology-Definition, Components, Classification Features; Technology Management-Concept, Nature; Drivers of Management of Technology-Significance, Scope, Responding to technology challenges.

**Technology Transfer:** Introduction, Definition, Classification, Significance, Elements of process, Types of Technology Transfer, Package, Modes of Transfer, Routes, Channels and Effectiveness of Technology Transfer.

**UNIT-V: CORPORATE GOVERNANCE: THE INDIAN SCENARIO****(09 Periods)**

Emergence of corporate governance in India-Landmarks, Models, Codes and status in India, Role and Responsibilities of Regulators, The Board of Directors; Corporate Governance- Specific issues in India, Family owned Business, Corporate Governance and the Indian ethos.

**Total periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Francis Cherunilam, *Strategic Management*, Himalaya Publishing House, 3<sup>rd</sup> Edition, 2002.
2. C. S. G. Krishnamacharyulu and Lalitha Ramakrishnan, *Management of Technology*, Himalaya Publishing House, Second Edition, 2012.

**REFERENCE BOOKS:**

1. White and Bruton, *The Management of Technology and Innovation: A Strategic Approach*, Cengage Learning, 1<sup>st</sup> Edition, 2007.
2. S.K.Mandak, *Ethics in Business and Corporate Governance*, TMH, 2<sup>nd</sup> Edition, 2012.

**III B. Tech. – I Semester**  
**(19BT40307) MANAGEMENT SCIENCE**  
(Open Elective-2)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Concepts of Management; Concepts Related to ethics and social responsibility; Human Resource Management; Operations Management; Statistical Process Control; Inventory Management; Marketing; Project Management; Project Crashing.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate the concepts of management, its functions and processes used in optimum resource utilization within the context of ethics and social responsibility.
- CO2: Apply the concepts of HRM for selection and management of human resources.
- CO3: Analyze different operations management problems using quality management tools to produce effective, efficient and adoptable products/services.
- CO4: Identify different marketing strategies to maximize enterprise profitability and customer satisfaction within the realistic constraints.
- CO5: Develop network models in time-cost tradeoff for effective project management.

**DETAILED SYLLABUS:**

**UNIT-I: MANAGERIAL FUNCTION AND PROCESS (10 Periods)**

Concept and foundations of management, Evolution of management thought; Managerial functions – Planning, Organizing, Directing and Controlling; Decision-making; Role of manager, managerial skills; Managing in a global environment, Flexible systems management; Social responsibility and managerial ethics; Process and customer orientation; Managerial processes on direct and indirect value chain.

**UNIT-II: HUMAN RESOURCE MANAGEMENT (08 Periods)**

Human Resource challenges; Human Resource Management functions; Human Resource Planning; Job analysis; Job evaluation, Recruitment and selection; Training and Development; Promotion and transfer; Performance management; Compensation management and benefits; Employee morale and productivity; Human Resource Information System.

**UNIT-III: OPERATIONS MANAGEMENT (10 Periods)**

Fundamentals of Operations Management, Services as a part of operations management; Facilities location and layout; Line balancing; Quality management – Statistical Process Control, Total Quality Management, Six sigma; Role and importance of materials management, Value analysis, Make or Buy decision, Inventory control, Materials Requirement Planning, Enterprise Resource Planning, Supply Chain Management.

**UNIT-IV: MARKETING MANAGEMENT****(08 Periods)**

Concept, evolution and scope; Marketing strategy formulation and components of marketing plan; Segmenting and targeting the market; Positioning and differentiating the market offering, Analyzing competition; Product strategy; Pricing strategies; Designing and managing marketing channels; Integrated marketing communications.

**UNIT-V: PROJECT MANAGEMENT****(09 Periods)**

Project management concepts; Project planning – Work Breakdown Structure, Gantt chart; Project scheduling – Critical Path Method, Program Evaluation and Review Technique, Crashing the project for time-cost trade off; Resource Levelling.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. MartandT. Telsang, *Industrial Engineering and Production Management*, S. Chand, 2<sup>nd</sup> Edition, 2006.
2. Koontz and Weihrich, *Essentials of Management*, TMH, 6<sup>th</sup> Edition, New Delhi, 2007.

**REFERENCE BOOKS:**

1. O.P. Khanna, *Industrial Engineering and Management*, Dhanpat Rai and Sons, 2010.
2. N.D. Vohra, *Quantitative Techniques in Management*, TMH, 2<sup>nd</sup> Edition, New Delhi.
3. L.M. Prasad, *Principles and practice of Management*, S. Chand and Sons, 2006.



**III B. Tech. – I Semester**  
**(19BT40504) CYBER LAWS AND SECURITY**  
(Open Elective-2)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Evolution of Cyberspace, Jurisdiction in the borderless Cyberspace, E-Contracting, Models of E-Commerce, Modes of Electronic signatures, E-Money, Intellectual Property Rights, Cybercrimes, Privacy and data security.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on jurisdiction in cyberspace and the impact of cybercrime to protect privacy on the Internet.
- CO2: Analyze the Indian cyber laws on E-Contracting, E-Commerce, E-signatures and E-money to promote digital law enforcement.
- CO3: Apply the knowledge of digital rights in Indian context to protect intellectual properties in electronic world.
- CO4: Practice ethics and cyber law regulations for leading electronic transactions on the Internet.

**DETAILED SYLLABUS:**

**UNIT-I: EVOLUTION OF CYBERSPACE AND JURISDICTION IN BORDERLESS CYBERSPACE (09 Periods)**

**The Evolution of Cyberspace:** Significance of information technology, Drawbacks in information technology, the digital divide, E-governance, Origin of cyberspace, Legal issues in cyberspace, regulating the Internet.

**Jurisdiction in the Borderless Cyberspace:** Meaning of jurisdiction, Three pre-requisites of jurisdiction, Jurisdictional theories in jurisdiction to prescribe, Tests to determine jurisdiction in Internet law cases, Indian laws to determine personal jurisdiction, Jurisdiction clauses in click wrap agreement.

**UNIT-II: ELECTRONIC CONTRACTING AND ELECTRONIC COMMERCE (09 Periods)**

**Electronic Contracting:** Formation of offline contracts under English common law, Fundamental requirements of an offline contract, Forming an E-contract through website, E-mail contracting, The Indian approach of E-contracts, Contract formation on the Internet and Information Technology Act 2000, B2C E-contracts.

**Electronic Commerce:** Models, Advantages, Restricted activities, Laws, India's information Technology Act 2000, Online customer protection in India (B2B, B2C).

### **UNIT-III: ELECTRONIC SIGNATURES AND ELECTRONIC MONEY (09 Periods)**

**Electronic Signatures:** The role of signatures, Significance of electronic signatures, Modes of electronic signatures, UNCITRAL model law on electronic signatures 2001, Cryptography, Role of certifying authority in PKI, The Indian Information Technology Act and electronic signatures- Electronic signatures, Prescribed authentication mechanisms, Secure electronic record.

**Electronic Money:** E-Money, RBI's guidelines on mobile banking and payments, The current E-payment systems, Earlier E-payment systems, Credit cards, Use of SET in online payment system.

### **UNIT-IV: INTELLECTUAL PROPERTY RIGHTS AND THE INTERNET WORLD**

**(09 Periods)**

Protecting copyright in the E-world, International organizations protecting Intellectual Property, Copyright issues on the Internet, Digital rights management, Patent protection and computer software, India and copyright protection for computer software, Business method patents- Position of Business methods patents in India, Trademark protection on the Internet, Cyber squatting, The Indian trademark law and legal remedies, Hyper linking and framing.

### **UNIT-V: CYBERCRIMES AND PROTECTING PRIVACY ON INTERNET (09 Periods)**

**Cybercrimes:** What is cybercrime, Categories, Different kinds of cybercrime, Cybercrimes and Information Technology Act, 2000 - Territorial scope and applicability, India's national cyber security policy.

**Protecting Privacy on the Internet:** Meaning of privacy, Threat to privacy on the Internet, Use of cookies and web bugs, Terms of use and privacy policy, Government right to interception, Employee privacy rights, Indian legal framework for data protection and privacy, Challenges to right of privacy in India.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOK(S):**

1. Karnika Seth, *Computers Internet and New technology Laws*, LexisNexis, 2013.

#### **REFERENCE BOOKS:**

1. Sarika Gupta, Gaurav Gupta, *Information Security and Cyber Laws*, Khanna Publishing, 2019.
2. Vivek Sood, *Cyber Law Simplified*, McGraw Hill, 2018.
3. Pavan Duggal, *Textbook on Cyber Law*, Universal LexisNexis, 2019.

#### **ADDITIONAL LEARNING RESOURCES:**

- [https://swayam.gov.in/nd2\\_cec20\\_cs09/preview](https://swayam.gov.in/nd2_cec20_cs09/preview)
- [https://swayam.gov.in/nd2\\_nou19\\_cs08/preview](https://swayam.gov.in/nd2_nou19_cs08/preview)

**III B. Tech. – I Semester**  
**(19BT50208) INTELLECTUAL PROPERTY RIGHTS**

(Open Elective-2)

(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to Intellectual Property; Trade Marks; Law of Copy Rights; Law of Patents; Trade Secrets; Unfair Competition; New Development of Intellectual Property.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the concepts of intellectual property right and new amendments enforced in filling intellectual property right.
- CO2: Understand the processes and principles of trade mark registration and apply them for registering trade mark.
- CO3: Understand the process and principles of copy rights for registration and judicial consequences for violating laws of copyright/patents.
- CO4: Understand the process and principles of trade secrets and judicial consequences for coping trade secrets.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO INTELLECTUAL PROPERTY (10 Periods)**

Introduction and the need for intellectual property rights (IPR); types of intellectual property- Design, Geographical Indication; International organizations, agencies and treaties.

**UNIT-II: TRADEMARKS (08 Periods)**

Introduction to trademark, Purpose and function of trademarks, acquisition of trade mark rights, protectable matter, selecting and evaluating trade mark, trade mark registration processes.

**UNIT-III: LAW OF COPYRIGHTS (09 Periods)**

Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law.

**Law of patents:** Foundation of patent law, patent searching process, ownership rights and transfer.

**UNIT-IV: TRADESECRETS (09 Periods)**

Trade secrete law, determination of trade secrete status, liability for misappropriations of trade secrets, protection for submission, trade secrete litigation.

**Unfair competition:** Misappropriation right of publicity, false advertising.

## **UNIT-V: NEW DEVELOPMENT OF INTELLECTUAL PROPERTY (09 Periods)**

New developments in: trade mark law, copy right law, patent law, intellectual property audits. International overview on intellectual property; international - trade mark law, copy right law, international patent law, international development in trade secrets law.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

### **TEXT BOOKS:**

1. Deborah, E. Bouchoux, *Intellectual property: The law of Trademarks, Copyright, Patents, and Trade Secrets*, Cengage learning, 4<sup>th</sup> edition, 2013.
2. PrabuddhaGanguli, *Intellectual property right - Unleashing the knowledge economy*, Tata McGraw Hill Publishing Company Ltd.

### **REFERENCE BOOKS:**

1. Neeraj P and Khusdeep D. *Intellectual Property Rights*. India, IN: PHI learning Private Limited. 1<sup>st</sup> edition 2019.

### **ADDITIONAL LEARNING RESOURCES:**

1. Subramanian, N., &Sundararaman, M. (2018). *Intellectual Property Rights – An Overview*. Retrieved from <http://www.bdu.ac.in/cells/ipr/docs/ipr-eng-ebook.pdf>
2. World Intellectual Property Organisation. (2004). *WIPO Intellectual property Handbook*. Retrieved from [https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo\\_pub\\_489.pdf](https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf)

**III B. Tech. – I Semester**  
**(19BT50409) GREEN TECHNOLOGIES**  
(Open Elective-2)  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Principles of green engineering; Green communications; Green energy; Green computing; Green construction; Green manufacturing.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze energy efficient communication systems such as Telecommunication systems, ICT, Wireless networks and cellular networks by understanding the principles of green communications.
- CO2: Understand the impact of conventional energy sources on environment and realize the significance and principles of green energy sources for sustainability.
- CO3: Understand the environmental impacts of IT and approaches for Green IT.
- CO4: Analyze concepts of sustainable green construction using appropriate tools and techniques following latest developments and considering safety and environment besides communicating effectively in graphical form.
- CO5: Demonstrate the environmental impact of traditional manufacturing and explore the need for green manufacturing process promoting sustainability.

**DETAILED SYLLABUS:**

**UNIT-I: PRINCIPLES OF GREEN ENGINEERING AND GREEN COMMUNICATIONS**  
**(09 Periods)**

**Principles of Green Engineering:** Introduction, Definition of green engineering, Principles of green engineering

**Green Communications:** Introduction, Origin of Green Communications, Energy Efficiency in Telecommunication systems, Telecommunication system model and energy Efficiency, Energy saving concepts, Quantifying energy efficiency in ICT, Energy efficiency metrics of green wireless networks, Embodied energy of communication devices- Introduction, The extended energy model, Embodied/Operating Energy of a BS in Cellular network- A Case study; Energy efficient standards for wireline communications.

**UNIT-II: GREEN ENERGY** **(09 Periods)**

Introduction, green energy systems - composition, adverse impacts, Green energy and sustainability, the target and solution. Diversification and localization of energy systems, green energy and sustainable development. Energy sources and their availability. Green energy sources - solar energy, wind energy, geothermal energy, ocean energy, biomass and biogas.

**UNIT-III: GREEN IT****(09 Periods)**

Introduction, Awareness to Implementation: Green IT Trends, Green Engineering, Greening by IT: Using RFID for Environmental Sustainability, Smart Grids, Smart Buildings and Homes, Green Supply Chain and Logistics, Enterprise-Wide Environmental Sustainability, A Seven-Step Approach to Creating Green IT Strategy: Balancing the Costs and Benefits of Going Green, Research and Development Directions.

**UNIT-IV: GREEN CONSTRUCTION****(09 Periods)**

**Green Building:** Concept, Necessity, Characteristics, Benefits, Requisites for green building construction, Sustainability, Concept of REDUCE, REUSE, RECYCLE, RETHINK, REPLENISH AND REFUSE (6 R's), Sustainable construction focus point – Site selection, Planning, Water, Energy, Material, Indoor air quality, Construction procedures, case studies of residential and commercial green buildings.

**Vastu:** Concept, History, scientific approach, elements of vastu for selecting a plot.

**Indian Green Building Council:** Introduction to IGBC green homes, Benefits of IGBC, IGBC green home rating system, Introduction to USGBC, LEED rating system, Procedure to get IGBC certification, GRIHA Rating.

**UNIT- V: GREEN MANUFACTURING****(09 Periods)**

Green Manufacturing - Introduction, Background and Definition; Impact of traditional manufacturing in environmental ecology, Need for green manufacturing, Motivation and barriers to green manufacturing, Advantages and Limitations of green manufacturing, Green manufacturing strategies, Green manufacturing and sustainability, Green manufacturing through clean energy supply, Green packaging and Supply chain.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Konstantinos Samdanis, Peter Rost, Andreas Maeder, Michela Meo, Christos Verikoukis, *Green Communications: Principles, Concepts and Practice*, John Wiley & Sons, 2015.
2. G.D. Rai, *Non-conventional Energy Sources*, Khanna Publishers, Delhi, 5th Edition, 2011.
3. San Murugesan, G.R. Gangadharan, *Harnessing Green IT – Principles and Practices*, John Wiley & Sons Ltd., 2008.
4. Tom Woolley, Sam Kimmins, Paul Harrison and Rob Harrison, *Green Building Handbook*, Volume 1, E & FN Spon, an imprint of Thomson Science & Professional.
5. J Paulo Davim, *Green Manufacturing: Processes and Systems*, Springer, 2012.
6. David A Dornfeld, *Green Manufacturing: Fundamentals and Applications*, Springer, 2013.

**REFERENCE BOOKS:**

1. Soli J. Arceivala, *Green Technologies for a better future*, McGraw Hill Education (India) Pvt. Ltd, 2014.
2. Marty Poniatowski, *Foundation of Green Information Technology*, Prentice Hall, 2009.
3. Athanasios V Alavanidis, Thomais Vlachogianni, *Green Chemistry and Green Engineering*, Synchrone Themata, 2012.

**III B. Tech. – I Semester**  
**(19BT50207) COMPUTER ORGANIZATION AND ARCHITECTURE**  
(Inter Disciplinary Elective-1)  
(Common to ECE, EEE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Digital Electronics.

**COURSE DESCRIPTION:** Concepts of computer structure, architecture and organization, Memory systems, Computer Arithmetic, 8085 Architecture, programming and Peripherals interfacing, Register transfer Hardwired control unit and Microprogrammed control unit.

**COURSE OUTCOMES:** After successful completion of this course, student will be able to:

- CO1: Understand the functional aspects of various functional units of a computer and also develop memory architecture of primary storage devices of required capacity.
- CO2: Understand the architecture and pin description of 8085 microprocessor and analyze the instruction cycle of various instructions using timing diagram.
- CO3: Develop optimized programs using 8085 assembly instructions for simple programs, memory and IO peripheral interface.
- CO4: Design of hardwired and microprogrammed control using by understanding the concept of computer arithmetic and organization.

**DETAILED SYLLABUS:**

**UNIT-I: STRUCTURE OF COMPUTERS AND MEMORY SYSTEMS (07 Periods)**

Structure of Computers: Computer Types, Functional Units, Basic Operational concepts, Bus Structures, Software and Performance. Memory System: Internal organization of memory chips—S SRAM, DRAM, ROM and cache memory, Memory hierarchy—speed, size and cost. Auxiliary memory—Magnetic disk, Flash memory.

**UNIT-II: 8085 ARCHITECTURE (11 Periods)**

Microprocessor evolution and types, introduction to 8085 architecture, Pin description, Register Organization, Timing Diagram, Instruction Set: Data transfer, arithmetic and logic, branch control, I/O and machine control instructions.

**UNIT-III: 8085 PROGRAMMING AND INTERFACING (10 Periods)**

Addressing modes, Interrupts of 8085, Simple programs, Interfacing– Memory interfacing, memory mapped I/O and I/O mapped I/O, Programmable peripheral interface IC 8255: Internal architecture and Modes of operation.

**UNIT-IV: COMPUTER ORGANISATION****(08 Periods)**

Organization—Register Transfer, Bus and memory transfers, Instruction Codes, Stored Program Organization, Indirect Address, Computer registers, Common Bus System, Computer Instructions, Instruction Set Completeness, RISC Vs CISC processors, Timing and control and Instruction cycle.

**UNIT-V: MICRO-PROGRAMMED CONTROL AND PIPELINING HAZARDS****(09 Periods)**

Microprogrammed Control: Control memory, address sequencing, Microprogram Example, design of control unit; Pipelining: Basic concepts, Data Hazards, Instruction Hazards, Out of order execution.

**Total Periods: 45**

***Topics for Self-study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. M. Moris Mano, *Computer System Architecture*, Pearson/PHI, 3rd edition, 2008.
2. Ramesh S Gaonkar, *Microprocessor - Architecture, Programming and Applications with the 8085*, Penram International Publishing Private Limited, 5th edition, 2007.

**REFERENCE BOOKS:**

1. Carl Hamacher, ZvonksVranesic, SafeaZaky, *Computer Organization*, Mc Graw Hill, 5th edition, 2002.
2. William Stallings, *Computer Organization and Architecture*, Pearson/PHI, 6th edition, 2003.

**ADDITIONAL LEARNING RESOURCES:**

1. NPTEL\_CAO: <https://nptel.ac.in/courses/106/105/106105163/>.
2. Coursera: <https://www.coursera.org/learn/comparch>
3. EDX : <https://www.edx.org/learn/computer-architecture>



**III B. Tech. - I Semester**  
**(19BT40501) COMPUTER NETWORKS**

(Inter Disciplinary Elective- 1)  
(Common to CSSE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to computer networks; Protocols of physical layer, data link layer, medium access control sub layer, network layer, transport layer, application layer.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the types of network topologies, layers and protocols.
- CO2: Evaluate sub netting and routing algorithms for finding optimal paths in networks.
- CO3: Solve problems related to flow control, error control and congestion control in data transmission.
- CO4: Assess the impact of wired and wireless networks in the context of network protocols Like DNS, SMTP, HTTP, and FTP.
- CO5: Apply ethical principles and standards for developing network-based solutions.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION AND PHYSICAL LAYER (09 Periods)**

Network hardware, Network software, Reference models - OSI, TCP/IP; Example networks - Internet; Wireless LANs - 802.11.

**Physical Layer** - Guided transmission media, Wireless transmission, Switching - Circuit switching, Packet switching.

**UNIT-II: DATA LINK LAYER AND MEDIUM ACCESS CONTROL SUBLAYER**

**(09 Periods)**

**Data Link Layer:** Data link layer design issues, Error detection and correction - CRC, Hamming codes; Elementary data link protocols, Sliding window protocols.

**Medium Access Control Sub layer:** ALOHA, Carrier sense multiple access protocols, Collision free protocols, Ethernet, Data link layer switching - Repeaters, Hubs, Bridges, Switches, Routers, Gateways.

**UNIT-III: NETWORK LAYER**

**(09 Periods)**

Network layer design issues, Routing algorithms - Shortest path algorithm, Flooding, Distance vector routing, Link state routing, Hierarchical routing, Broadcast routing, Multicast routing, Anycast routing; Congestion control algorithms, Network layer in the internet - The IP version 4 protocol, IP addresses, IP version 6, Internet control protocols, OSPF, BGP.

**UNIT-IV: TRANSPORT LAYER****(09 Periods)**

UDP – Segment header, Remote procedure call, Real-time transport protocols; TCP – service model, Protocol, Segment header, Connection establishment, Connection release, Sliding window, Timer management, Congestion control.

**UNIT-V: APPLICATION LAYER****(09 Periods)**

Domain Name System (DNS) - Name space, Domain resource records, Name servers; Electronic mail - Architecture and services, User agent, Message formats, Message transfer, Final delivery; The World Wide Web - Architectural overview, HTTP, FTP.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOK:**

1. Andrew S. Tanenbaum and David J. Wetherall, *Computer Networks*, Pearson, 5<sup>th</sup> Edition, 2015.

**REFERENCE BOOKS:**

1. Behrouz A. Forouzan, *Data Communications and Networking*, McGraw Hill, 5<sup>th</sup> Edition, 2013.
2. James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach*, Pearson, 7<sup>th</sup> Edition, 2017.

**ADDITIONAL LEARNING RESOURCES:**

- <https://www.cisco.com/c/en/us/solutions/small-business/resourcecenter/networking/networking-basics.html>
- <https://memberfiles.freewebs.com/00/88/103568800/documents/Data.And.Compute.r.Communications.8e.WilliamStallings.pdf>

**III B. Tech. – I Semester**  
**(19BT21501) OBJECT ORIENTED PROGRAMMING THROUGH JAVA**  
(Inter Disciplinary Elective- 1)  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Programming for Problem Solving

**COURSE DESCRIPTION:** Introduction to Object Oriented Programming, Classes and Objects; Inheritance, Packages, Interfaces; Exception handling, Multithreading; Collection Classes; Applets, Swings, Event handling.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on object oriented programming constructs to solve programming problems.
- CO2: Analyze object oriented programming features – polymorphism, inheritance, exception handling and multithreading for reusability.
- CO3: Develop user interfaces using GUI programming techniques.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION (09 Periods)**

Introduction to Object Oriented Programming, Java Buzzwords, History, Java Environment, Java Components, Programming Paradigms, Naming Conventions.

**Classes and Objects:** Introduction to classes, objects, Constructors, Garbage Collection, this keyword, Access Control, Features of Object Oriented Programming.

**UNIT-II: DATA TYPES, CONTROL STATEMENTS, POLYMORPHISM (09 Periods)**

Data Types, Variables, Type Conversions (Boxing and Unboxing/Wrapping and Unwrapping) and Casting, Arrays, Operators, Decision Making Statements, Looping Statements, Methods, Recursion, Method Overloading, Constructor Overloading, Parameter Passing, String Class, Final Keyword.

**Utility Classes:** String To kenizer, Scanner, Random, Bit Set.

**UNIT-III: INHERITANCE, PACKAGES, INTERFACES (09 Periods)**

**INHERITANCE:** Introduction, Classification, Abstract Classes, Final keyword with Inheritance.

**PACKAGES:** Basics, Creating and Accessing a package, CLASSPATH, Importing packages.

**INTERFACES:** Definition, Implementing Interfaces, Extending Interfaces, Nested Interfaces, Applying Interfaces, Variables in Interfaces.

#### **UNIT-IV: EXCEPTION HANDLING, MULTITHREADING, COLLECTION FRAMEWORK (09 Periods)**

**EXCEPTION HANDLING:** Exception, Types of Exception, Keywords: try, catch, throw, throws and finally, Built-in Exceptions, User Defined Exceptions.

**MULTITHREADING:** Process, Thread, Thread Model, Creating a thread, Priorities, Thread Synchronization, Inter-thread Communication.

**COLLECTION FRAMEWORK:** Framework Hierarchy, Array List, Linked List, Hash Set.

#### **UNIT-V: APPLETS, SWINGS, EVENT HANDLING (09 Periods)**

**APPLET CLASS:** Basics, Types, Architecture, Skeleton, Parameter passing to applets.

**SWINGS:** Introduction, Features, Hierarchy, Swing GUI Components, Packages in Swings, Swing Control Classes and Methods.

**EVENT HANDLING:** Event Classes, Event Listener Interfaces - Mouse and Key, Adapter Classes.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOK:**

1. Herbert Schildt, *Java the Complete Reference*, Ninth Edition, Oracle Press, 2014.

#### **REFERENCE BOOKS:**

1. Sachin Malhotra and Saurab Choudhary, *Programming in Java*, Second Edition, Oxford University press, 2014.
2. Y. Daniel Liang, *Introduction to Java Programming*, Pearson Education.
3. T. Budd, *Understanding Object-Oriented Programming with Java*, Pearson Education.

#### **ADDITIONAL LEARNING RESOURCES**

- <https://docs.oracle.com/javase/tutorial/index.html>

**III B. Tech. – I Semester**  
**(19BT50408) MICROELECTROMECHANICAL SYSTEMS**  
(Inter Disciplinary Elective- 1)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Engineering Physics.

**COURSE DESCRIPTION:** Overview of Micro Electro Mechanical Systems (MEMS), working principles of microsensors and microactuators, materials, micro fabrication processes, MEMS accelerometers, packaging of Microsystems and applications over different fields.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Demonstrate MEMS Components like microsensors and microactuators.

CO2: Understand working methodologies of MEMS accelerometers.

CO3: Use micro fabrication techniques and device packaging methods in manufacturing MEMS devices.

CO4: Analyze various MEMS devices for engineering applications.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO MEMS AND MICROSYSTEMS (09 Periods)**

Introduction to MEMS, Energy domains and transducers, sensors and actuators, Microsystems versus MEMS, miniaturization, MEMS materials.

**UNIT-II: MICROSENSORS & ACTUATORS (09 Periods)**

**Microsensors:** Classification of physical sensors, Integrated, Intelligent or Smart sensors, Sensor Principles and Examples: Thermal sensors, Pressure, Flow, Inertial, Gyro sensors, Bio Sensors.

**Microactuators:** Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotors.

**UNIT-III: MEMS ACCELEROMETERS (07 Periods)**

Micro accelerometers for MEMS, Temperature and Damping analysis, Piezoelective accelerometer, Piezoresistive accelerometer, Piezocapacitive accelerometer technology.

**UNIT-IV: MEMS FABRICATION AND PACKAGING (12 Periods)**

Review of Fabrication process-Photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition, deposition by Epitaxy, Czochralski process.

Micromachining technology of MEMS, Microstereolithography; Introduction to microsystem packaging, objectives and general considerations in packaging design, three levels of microsystem packaging.

#### **UNIT-V: MEMS APPLICATIONS**

**(08 Periods)**

Applications of MEMS in the automotive industry, avionics and space applications and commercial applications, RF MEMS, optical MEMS, Introduction to Bio MEMS and microfluidics.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOK:**

1. Tai-Ran Hsu, *MEMS & Microsystems, Design and Manufacture*, McGraw Hill Education (India) Pvt. Ltd., 27th reprint, 2018.

#### **REFERENCE BOOKS:**

1. G.K.Ananthasuresh, K.J.Vinoy, *Micro and Smart Systems*, New Delhi publication, 1<sup>st</sup> edition, 2011 Education (India) Pvt. Ltd.
2. Nitaigour Premchand Mahalik, *MEMS*, McGraw Hill Education (India) Pvt. Ltd., 11<sup>th</sup> reprint, 2016.

**III B. Tech. – I Semester**  
**(19BT61531) INTERNET OF THINGS LAB**  
(Common to ECE, EEE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | 1 | 2 | 2 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:**

Setting up **IoT** work-flow, Programming with Python, Micro-controller programming using Arduino, Building **IoT** Applications using Raspberry Pi, **IoT** Cloud Infrastructure.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Design an interface to embedded systems using real time sensors with Arduino and Raspberry Pi.

CO2: Develop applications to capture the data generated by sensors and send to cloud.

CO3: Develop real time applications using NodeMCU and BLYNK.

CO4: Design applications to push sensor data to cloud using MQTT protocol.

CO5: Work independently and in team to solve problems with effective communication.

**Theory Component:**

**(10 Periods)**

Arduino IDE, 7-segment display, Servo motor, ultrasonic sensor, LCD, Flame sensor, gas sensor, Humidity & temperature sensors, MQTT protocols, ECG System, Raspberry Pi, Home security system with camera, PIR sensor, light sensor, motion detector, NodeMCU, BLYNK, cloud

**LIST OF EXPERIMENTS:**

1. (a) Design and Simulate LED 7-Segment Display interfacing with Arduino.  
(b) Design and Simulate Servo motor interfacing with Arduino.
2. (a) Design and Simulate ultrasonic sensor and LCD interfacing with Arduino.  
(b) Design and Simulate Flame Sensor interfacing with Arduino.
3. Design and Implement to capture Gas Sensor and send sensor data to cloud from your NodeMCU device using Arduino IDE.
4. Design and Implementation of Humidity and Temperature Monitoring Using Arduino and upload data to cloud using MQTT.
5. Design and Implementation of an IoT ECG (Electrocardiogram) System to record hearts electrical activity.
6. Design and Simulate controlling an LED 7-Segment Display with Raspberry Pi.
7. Design and implementation of Raspberry Pi Home Security System with Camera and PIR Sensor with Email Notifications.
8. Design and Implement to upload Light sensor (TSL) data to cloud through Raspberry Pi.
9. Design and Implementation of Motion Detector with NodeMCU and BLYNK.
10. Design and Implementation of Fire notification IoT system with BLYNK.

**REFERENCE BOOKS:**

1. Adrian McEwen and Hakin Cassimally, *Designing the Internet of Things*, Wiley India.
2. Simon Monk, *Programming Aurdino*, Second Edition, McGraw-Hill Education, 2016.
3. Matt Richardson and Shawn Wallace, *Getting Started with Raspberry Pi*, O'Reilly, 2014.
4. Rahul Dubey, *An Introduction to Internet of Things: Connecting Devices, Edge Gateway, and Cloud with Applications*, Cengage Learning India Pvt. Ltd, 2019



**III B. Tech. –I Semester**  
**(19BT50431) ANALOG AND DIGITAL COMMUNICATIONS LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** Courses on Signals and systems & Analog Communications.

**COURSE DESCRIPTION:** Simulation and verification of various analog and digital modulation schemes.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze, measure and validate the practical observations by applying the conceptual knowledge of various Analog modulations.
- CO2: Analyze, measure and validate the practical observations by applying the conceptual Knowledge of various Digital modulation schemes & Techniques.
- CO3: Simulate various Analog and Digital modulations Using MATLAB tool.
- CO4: Work independently or in teams to solve problems with effective communication.

**List of Exercises/List of Experiments:**

(Minimum **Ten** Experiments are to be conducted):

1. Amplitude modulation and demodulation(AM, DSB-SC,SSB)
2. Frequency modulation and demodulation.
3. Pulse Analog Modulation & Demodulation (PAM,PWM,PPM)
4. Verification of Sampling Theorem
5. Study the Pulse code modulation system.
6. Study the Delta Modulation system.
7. Perform Digital carrier modulations (ASK, PSK, FSK, DPSK)
8. Spectral analysis of AM signals using spectrum analyzer.
9. Generate the AM and FM signals using MATLAB
10. Generate the PSK & FSK modulation and demodulation signals using MATLAB
11. Generate the QPSK & DPSK modulation and demodulation signals using MATLAB
12. Generate the PCM and DM modulation and demodulation signals using MATLAB
13. Design of Matched filter and constellation diagrams using MATLAB.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Herbert Taub, Donald L Schilling, Goutam Sana, *Principles of Communication Systems*, McGraw-Hill, 4<sup>th</sup> Edition, 2012.
2. B.P.Lathi, Zhi Ding *Modern Digital and Analog Communication Systems*, Oxford, 4<sup>th</sup> Edition, 2012.
3. Simon Haykin, *Digital Communications Systems*, Wiley, 2013.
4. K. Sam Shanmugam, *Digital and Analog Communication Systems*, Wiley, 2019.
5. R.P Singh and S.D Sapre, *Communication Systems Analog and Digital*, McGraw Hill Education, 3<sup>rd</sup> Edition, 2017.

**SOFTWARE/Tools used: MATLAB****Major Equipments required for Laboratories:**

1. CROs: 20MHz
2. Function Generators: 2MHz
3. Spectrum Analyzer
4. Regulated Power Supplies: 0-30V
5. MAT Lab/Equivalent Simulation Package with Communication tool box
6. Analog and Digital Modulation and Demodulation Trainer Kits.

**III B. Tech. - I semester**  
**(19BT50432) SOCIALLY RELEVANT PROJECT-I**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | - | 1 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:**

Identification of topic for the socially relevant project; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the socially relevant project; Preparation of thesis and presentation.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Create/Design engineering systems or processes to solve complex societal problems using appropriate tools and techniques following relevant standards, codes, policies, regulations and latest developments.
- CO2: Consider environment, sustainability, economics and project management in addressing societal problems.
- CO3: Perform individually or in a team besides communicating effectively in written, oral and graphical formson socially relevant project.

**III B. Tech. - I Semester**  
**(19BT503AC) FOUNDATIONS OF ENTREPRENEURSHIP**

(Audit Course)

(Common to CE, ME, ECE, EEE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| -          | -          | -           | 2 | - | - | - |

**PREREQUISITE: --**

**COURSE DESCRIPTION:** The nature and growth of entrepreneurship; Characteristics of an entrepreneur; Types of Entrepreneurs; Ethics and social responsibility of entrepreneurs; Generating ideas; Opportunity identification; Implementing and managing the venture; Principles of creativity and innovation; Methods of protecting innovation and creativity; Market research; Feasibility analysis; Sources of funding; Preparation of business plan; Start-Ups; Social Entrepreneurship; Rural entrepreneurship.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on personal attributes that enable best use of entrepreneurial opportunities.
- CO2: Apply suitable method to protect creativity and innovation.
- CO3: Design and prepare high impact strategic and business plan.
- CO4: Analyze the major steps and requirements in order to convert innovative idea into a successful start-up.
- CO5: Develop an idea to create a business for social change by identifying social entrepreneurship opportunities.

**DETAILED SYLLABUS:**

**UNIT-I: ENTREPRENEURIAL MINDSET (06 Periods)**

The nature and growth of entrepreneurship, Entrepreneurship and Intrapreneurship, Characteristics of an entrepreneur, Types of Entrepreneurs, Women as an Entrepreneur, Factors that contribute to the success of entrepreneurs, Ethics and social responsibility of entrepreneurs.

**UNIT-II: ENTREPRENEURIAL PROCESS (06 Periods)**

Generating ideas, Opportunity identification, Business concepts, Resources (Financial, Physical and Human), Implementing and managing the venture, Harvesting the venture, Harvesting strategies: Absorption of new concept into mainstream operations, Licensing of rights, Family succession, Liquidate (Shut down) venture, Selling the venture, Management Buy-Out (MBO).

**UNIT-III: CREATIVITY AND INNOVATION (06 Periods)**

Principles of creativity and innovation, Disruptive, incremental and open innovations, Nurturing and managing innovation, Methods of protecting innovation and creativity: Intellectual property rights, Branding, Trademarks, Patents, Copyrights, Registered design protection, Trade secrets.

#### **UNIT-IV: NEW VENTURE PLANNING AND CREATION (06 Periods)**

Market research (venture opportunity screening), Feasibility analysis, Start-up capital;

Sources of funding: equity financing, debt financing (loans, venture funding, angel funding), grants, gifts, bequests and financial statements, Introduction to the business plan, Preparation of business plan.

#### **UNIT-V: START-UPS AND SOCIAL ENTREPRENEURSHIP (06 Periods)**

**Start-Ups:** Definition to start-up, Start-up activities, Promising start-ups, Venture-backed start-ups, Corporate-supported start-ups.

**Social Entrepreneurship:** Social enterprise-Need - Types - Characteristics and benefits of social enterprises, Rural entrepreneurship.

**Total Periods: 30**

**Topics for Self-Study are provided in the Lesson Plan**

#### **TEXT BOOKS:**

1. Robert D. Hisrich, Mathew J. Manimala, Michael P. Peters, Dean A. Shepherd, *Entrepreneurship*, McGraw Hill Education (India) Private Limited, Eighth Edition, 2013.
2. Marc J Dollinger, *Entrepreneurship: Strategies and Resources*, Pearson, Third Edition, 2003.

#### **REFERENCE BOOKS:**

1. Vasant Desai, *Dynamics of Entrepreneurial Development and Management*, Himalaya Publ. House, 2004.
2. *Harvard Business Review on Entrepreneurship*, HBR Paper Back.
3. Thomas W. Zimmerer & Norman M. Scarborough, *Essential of Entrepreneurship and small business management*, PHI.

### III B. Tech. - II Semester

#### (19BT6HS01) PRINCIPLES OF BUSINESS ECONOMICS AND ACCOUNTANCY

(Common to ECE, EEE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

#### PRE-REQUISITES: -

**COURSE DESCRIPTION:** Business economics and demand analysis; theory of production and cost analysis; markets and pricing; principles of accounting and capital; final accounts and tally erp 9.0

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate Knowledge in concepts, principles and significance of Business Economics, Financial accounting and Tally ERP 9.0
- CO2: Demonstrate analytical skills in managerial decision making of an organization by applying theories of Economics
- CO3: Develop effective communication in Business and Accounting transactions.
- CO4: Ascertain the profitability and soundness of an organization.
- CO5: Preparing Financial Statements

#### DETAILED SYLLABUS:

##### UNIT-I: BUSINESS ECONOMICS AND DEMAND ANALYSIS (09 Periods)

Definition - Nature and Scope of Business Economics - **Demand:** Determinants of demand – Demand function - Law of demand, assumptions and exceptions - Elasticity of demand – Types of elasticity of demand - Demand forecasting and methods of demand forecasting.

##### UNIT-II: THEORY OF PRODUCTION AND COST ANALYSIS (09 Periods)

**Production Function:** Input-output relationship - Law of Variable proportion- Isoquants and Isocosts

**Cost Concepts:** Total, Average and Marginal Cost - Fixed vs. Variable costs – Opportunity Costs Vs Outlay Costs– Separable Costs Vs Joint Costs, Urgent Costs Vs Postponable Costs- Avoidable Costs Vs Unavoidable Costs

**Break Even Analysis (BEA)** – Assumptions, Merits and demerits - Determination of Break Even Point (Simple problems).

##### UNIT-III: MARKETS AND PRICING (09 Periods)

**Market Structure:** Types of Markets - Features of perfect competition - Monopoly and monopolistic competition - Price and Output determination in perfect competition, monopoly and monopolistic Markets.

**Pricing:** Objectives and policies of pricing – Sealed bid pricing - Marginal cost pricing - Cost plus pricing - Going rate pricing – penetration Pricing –skimming Pricing - Block pricing – Peak load pricing - Cross subsidization.

**UNIT-IV: PRINCIPLES OF ACCOUNTING & CAPITAL (09 Periods)**

**Accountancy:** Introduction – Concepts – Conventions – Double Entry Book Keeping – Journal – Ledger - Trial Balance (Simple problems)

**Capital:** Significance - Types of capital – Sources of Capital.

**UNIT-V: FINAL ACCOUNTS & TALLY ERP 9.0 (09 Periods)**

**Introduction to Final Accounts** - Trading account - Profit and Loss account and Balance Sheet with simple adjustments (Simple problems)

**Tally ERP 9.0:** Introduction – Create a company – Create ledger – Posting vouchers – Advantages of Tally.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. H L Ahuja, *Business Economics (Thirteenth edition)*, S Chand Publishing, Jan 2016.
2. Larry M. Walther, *Financial Accounting*, Create Space Independent Publishing Platform, July 2017.

**REFERENCE BOOKS:**

1. Joseph G.Nellis and David Parker, *Principles of Business Economics*, Pearson Education Canada, 2<sup>nd</sup> edition, 2016.
2. S.P. Jain and K.L. Narang, *Financial Accounting*, Kalyani Publishers, Ludhiana, 12<sup>th</sup> edition, 2018.

**III B. Tech. – II Semester**  
**(19BT60401) ANTENNAS AND PROPAGATION**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Electromagnetic Fields and Transmission Lines

**COURSE DESCRIPTION:** Antenna Parameters; Wire antennas; Antenna Arrays; VHF, UHF and Microwave antennas; Antenna Measurements and Wave propagation.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design various antennas with required radiation levels for communication needs, meeting the public health and safety conditions.
- CO2: Develop high gain antenna arrays for satellite, radar and mobile applications.
- CO3: Analyze antenna parameters such as radiation pattern, directivity and gain by various measurement methods.
- CO4: Analyze different modes of wave propagation through various layers of atmosphere.

**DETAILED SYLLABUS:**

**UNIT-I: ANTENNA BASICS AND THIN LINEAR WIRE ANTENNAS (10 Periods)**

Introduction, Radiation mechanism, Antenna parameters patterns, Beam Area, Radiation Intensity, Beam Efficiency, Directivity-Gain-Resolution, Antenna Apertures, Effective height; Antenna Field Zones, Antenna theorems, Friis transmission equation, Retarded potentials, Radiation from small electric dipole, Quarter wave monopole and half wave dipole Current distributions, Field components, Radiated power, Radiation resistance, Beam width, Directivity, Effective area and Effective height; Natural current distributions, far-fields and patterns of Thin linear center-fed antennas of different lengths, Illustrative problems.

**UNIT-II: ANTENNA ARRAYS (09 Periods)**

Point sources- Definition, Patterns, arrays of 2 isotropic sources different cases; Principle of pattern multiplication, Uniform linear arrays - Broadside arrays, End fire arrays, EFA with increased directivity, Derivation of their characteristics and comparison, BSA with non-uniform amplitude distribution - General considerations and Binomial arrays, Arrays with parasitic elements, Yagi-Uda arrays, Folded dipoles & their characteristics, Illustrative problems.

**UNIT-III: VHF, UHF AND MICROWAVE ANTENNAS (10 Periods)**

Helical Antennas - Helical geometry, Helix modes, Practical design considerations for monofilar helical antenna in axial and normal modes, Horn antenna, Microstrip antennas - Introduction, Features, Advantages and limitations; Rectangular patch antennas - Geometry and parameters, characteristics of microstrip antennas, Impact of different parameters on characteristics; Reflector types-paraboloidal, cassegrain, feed methods for parabolic reflectors; RF radiation hazards and solutions, Illustrative problems.



**UNIT-IV: ANTENNA MEASUREMENTS****(07 Periods)**

Introduction, Concepts- Reciprocity, Near and far fields, Coordinate system, Sources of errors, Pattern measurement arrangement, Measurement of Directivity, Gain (by comparison, Absolute and 3-Antenna Methods), Radiation pattern.

**UNIT-V: WAVE PROPAGATION****(09 Periods)**

Introduction, Modes of wave propagation, Ground wave propagation, Space wave propagation- Introduction, field strength variation with distance and height, effect of earth's curvature, absorption; Super refraction, M-curves and duct propagation, scattering phenomena, troposphere propagation, fading. Sky wave propagation - Introduction, structure of Ionosphere, refraction and reflection of sky waves by Ionosphere, Ray path, Critical frequency, MUF, LUF, OF, Virtual height and Skip distance, Relation between MUF and Skip distance, Multi-Hop propagation.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOK:**

1. John D. Kraus and Ronald J. Marhefka and Ahmad S.Khan, *Antennas and Wave Propagation*, TMH, 4th Edition, 2017.

**REFERENCE BOOKS:**

1. C.A. Balanis, *Antenna Theory*, John Wiley & Sons, 2nd Edition, 2007.
2. G.S.N.Raju, *Antennas and Wave Propagation*, Pearson Education India, 1st Edition, 2006.

**ADDITIONAL LEARNING RESOURCES:**

1. [https://onlinecourses.nptel.ac.in/noc20\\_ee20/unit?unit=7&lesson=8](https://onlinecourses.nptel.ac.in/noc20_ee20/unit?unit=7&lesson=8)
2. [https://onlinecourses.nptel.ac.in/noc20\\_ee20/unit?unit=7&lesson=9](https://onlinecourses.nptel.ac.in/noc20_ee20/unit?unit=7&lesson=9)

**III B. Tech. - II semester**  
**(19BT60402) MICROCONTROLLERS**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** Courses on Switching Theory and Logic Design & Linear and Digital IC Applications

**COURSE DESCRIPTION:** 8051 Microcontroller - Architecture, programming, interrupts and applications; PIC microcontroller architecture, Interrupts and timers of PIC microcontroller, interfacing

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze Architectural features and Instruction Set of 8051 for control applications.
- CO2: Analyze PIC18 Architecture and Instruction Set to develop computing applications.
- CO3: Develop Programs for PIC18 using ports, timers and associated on Chip resources for Specified Applications.
- CO4: Design microcomputer based systems with the knowledge of Interfaces and Peripherals of PIC18 to Solve various engineering problems.

**DETAILED SYLLABUS:**

**UNIT-I: 80C51/31 (10 Periods)**

Microprocessors vs Microcontrollers, 8051 Architecture, Internal and external memories, Addressing modes, Timers/Counters structure & configuration, Instruction set of 8051, simple programs using 8051.

**UNIT-II: PIC ARCHITECTURE & PROGRAMMING (10 Periods)**

Architecture of PIC18, Register Organization, Memory Organization - ROM space & RAM; Data formats & Directives, Instruction Set: Arithmetic, Logic, branching, Bit wise, bank switching, Simple PIC Programs.

**UNIT-III: PORTS, TIMERS & PROGRAMMING (10 Periods)**

Pin description of PIC18F452, Basic Port Structure, I/O port programming; Macros and modules, Structure of Timer 0 & its Programming using Assembly and C, Counter programming, Structure of timers 1, 2 and 3 & their Programming.

**UNIT-IV: PIC-SERIAL PORT AND INTERRUPTS (07 Periods)**

Basics of communication – Serial/Parallel, RS232 & PIC18 connection to RS232, Serial Port Structure & programming; PIC18 interrupts, Programming timer interrupts, Programming serial interrupts.

**UNIT-V: PIC INTERFACING****(08 Periods)**

7 segment LED and LCD interfacing, keyboard interfacing, interfacing ADC, DAC, Interfacing DC motor, stepper motor, PWM using CCP.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D, *The 8051 Microcontroller and Embedded Systems-using assembly and C*, PHI, 2006/ Pearson New International Edition 2014
2. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny causey, *PIC Microcontroller and Embedded Systems: Using C and PIC18*, Pearson Education, 2015.

**REFERENCE BOOKS:**

1. Kenneth J. Ayala, *The 8051 Microcontroller-Architecture, Programming & Applications*, 3<sup>rd</sup> Edition, Cengage learning, June 2007.
2. Ramesh S. Gaonkar, *Fundamentals of Microcontrollers and Applications in Embedded Systems (With PIC18 Microcontroller Family)*, Penram International, 2010.
3. M Rafiquzzaman, *Microcontroller Theory And Applications With The PIC*, Wiley India Publications, March 2014

**ADDITIONAL LEARNING RESOURCES:**

1. <http://crystal.uta.edu/~zaruba/CSE3442/>
2. <https://owd.tcnj.edu/~hernande/ELC343/>
3. <http://www.ciebookstore.com/Content/Images/uploaded/PIC18-Study-Guide-CIE.pdf>

**III B. Tech. – II Semester**  
**(19BT60403) ADVANCED DIGITAL SIGNAL PROCESSING**  
(Professional Elective- 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Digital Signal Processing

**COURSE DESCRIPTION:** Digital filter banks; Parametric and Non-Parametric Power Spectrum Estimation methods; Linear Prediction; Computationally efficient algorithms.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design digital Filter Banks to improve performance characteristics of digital systems in multidisciplinary environments like image processing, wireless communication, biomedical engineering, speech processing, video processing, etc
- CO2: Realize, compare and estimate power spectrum using different Non-Parametric and Parametric Methods in the frequency analysis of systems.
- CO3: Develop optimal Lattice Forward and Backward Predictors for Radar signal Processing and Remote sensing.
- CO4: Analyze various DSP algorithms in Linear filtering.

**DETAILED SYLLABUS:**

**UNIT-I: MULTIRATE FILTER BANKS (10 Periods)**

Decimation, Interpolation, Sampling rate conversion by a rational factor I/D, Multistage Implementation of sampling rate conversion. Digital Filter Banks: Two-Channel Quadrature-Mirror Filter Bank, Elimination of aliasing, condition for Perfect Reconstruction, Polyphase form of QMF bank, Linear phase FIR QMF bank, IIR QMF bank, Acquisition of high quality data, Multirate narrow band digital filtering.

**UNIT-II: POWER SPECTRAL ESTIMATIONS (08 Periods)**

Estimation of spectra from finite duration observation of signals, Non Parametric Methods: Bartlett, Welch, Blackmann&Tukey methods. Performance Characteristics of Nonparametric Power Spectrum Estimators, Computational Requirements of Nonparametric Power Spectrum Estimates.

**UNIT-III: PARAMETRIC METHODS OF POWER SPECTRAL ESTIMATION (08 Periods)**

Autocorrelation & Its Properties, Relation between auto correlation & model parameters, Yule-Walker & Burg Methods, MA & ARMA models for power spectrum estimation.

**UNIT-IV: LINEAR PREDICTION (10 Periods)**

Forward and Backward Linear Prediction – Forward Linear Prediction, Backward Linear Prediction, Optimum reflection coefficients for the Lattice Forward and Backward Predictors. Solution of the Normal Equations: Levinson Durbin Algorithm, Schur Algorithm. Properties of Linear Prediction Filters

**UNIT-V: DSP ALGORITHMS****(09 Periods)**

Fast DFT algorithms based on Index mapping, Sliding Discrete Fourier Transform, DFT Computation Over a narrow Frequency Band, Split Radix FFT, Linear filtering approach to Computation of DFT using Chirp Z-Transform.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. John G. Proakis, Dimitris G. Manolakis, *Digital signal processing, principles, Algorithms and applications*, Prentice Hall, 4<sup>th</sup> edition, 2007.
2. Sanjit K Mitra, *"Digital signal processing, A computer base approach"*, McGraw-Hill Higher Education, 4<sup>th</sup> edition, 2011.

**REFERENCE BOOKS:**

1. Emmanuel C Ifeacher Barrie. W. Jervis, *"DSP-A Practical Approach"*, Pearson Education, 2<sup>nd</sup> edition, 2002.
2. A.V. Oppenheim and R.W. Schaffer, *"Discrete Time Signal Processing"*, PHI, 2<sup>nd</sup> edition, 2006.

**III B. Tech. – II Semester**  
**(19BT60404) ARM AND AVR CONTROLLERS**  
(Professional Elective- 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Switching Theory and Logic Design & Linear and Digital Integrated Circuits.

**COURSE DESCRIPTION:** ARM Architecture; ARM Instruction Set; ARM Programming; AVR Architecture; AVR Programming in Assembly Language & C;

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze ARM Architectures and Instruction Set to develop fundamental Programs .
- CO2: Develop efficient ARM based Prototypes by analyzing modes of ARM operation to program ARM Cortex M3 at Assembly and high levels.
- CO3: Realize efficient Embedded Systems with an understanding of limitations by evaluating architectural features of AVR Family Microcontrollers.
- CO4: Apply Programming techniques at Assembly and High Level to develop industry standard microcontroller based systems.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO ARM ARCHITECTURE (09 Periods)**

Introduction to ARM family of processors and controllers, Architecture of ARM Cortex M3, Cortex M3 fundamentals, registers, Operation modes, ARM Instruction Set: Data transfer, Data Processing Call & Branch, Bit Manipulation, Pseudo Instructions and other useful instructions in Cortex M3, ARM Assembly Language Programming.

**UNIT-II: THUMB PROGRAMMING & OTHER ARM FEATURES (09 Periods)**

Thumb Instruction Set, ARM Mode & Thumb mode Programming, ARM Programming in C. Memory system, memory map, Memory system attributes, ARM Pipeline, Exception types, Cortex M3 Processor applications.

**UNIT-III: INTRODUCTION to AVR MICROCONTROLLER (09 Periods)**

Overview of AVR family, AVR Microcontroller architecture, status register, Special function registers, RAM, ROM & EEPROM space, On-Chip peripherals, ATmega32 pin configuration & function of each pin, Fuse bits of AVR.

**UNIT-IV: AVR ASSEMBLY LANGUAGE PROGRAMMING (10 Periods)**

AVR data types and assembler directives, Addressing modes of AVR, Data transfer, Arithmetic, Logic and Compare, Rotate and Shift, Branch and Call instructions, AVR studio setup for assembly language programming, AVR I/O Port Programming, Time delay loop, Look-up table, Bit addressability, MACROs, Intel HEX file.

**UNIT-V: AVR PROGRAMMIN IN C****(08 Periods)**

AVR Data types, AVR I/O port programming, Timer programming, Input capture and Wave Generator, PWM programming External Interrupt programming, ADC programming, EEPROM programming.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Joseph Yiu, *The Definitive Guide to the ARM Cortex-M3 & M4*, Elsevier, 3<sup>rd</sup> Edition, January 2014.
2. Muhammad Ali Mazidi, SarmadNaimi and SepehrNaimi, *The AVR Microcontroller and Embedded Systems Using Assembly and C*, Pearson Education, January 2014.

**REFERENCE BOOKS:**

1. Ramesh Gaonkar, *Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family)*, Penram International, First edition, 2010
2. Andrew Sloss, Dominic Symes, Chris Wright, *ARM System Developer's Guide: Designing and Optimizing System Software (The Morgan Kaufmann Series in Computer Architecture and Design)*, October 2004.
3. AVR ATmega32 data sheet

**III B. Tech. – II Semester**  
**(19BT60405) DIGITAL IC DESIGN**  
(Professional Elective- 2)  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on VLSI Design

**COURSE DESCRIPTION:** Introduction to MOS transistors; Characteristics of CMOS digital circuits; Transistor Sizing; memory design; Design strategies; Design of subsystems.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Design combinational and Sequential logic circuits using various design styles.

CO2: Analyze timing issues to improve the performance of sequential logic circuits.

CO3: Develop memories and sub systems using CMOS logic for high speed networks.

CO4: Analyze design methodologies and tools at various levels of abstraction.

**DETAILED SYLLABUS:**

**UNIT-I: CMOS INVERTER CHARACTERISTICS AND DESIGN STYLES (09 Periods)**

**MOS Inverters:** Introduction, Definitions and Properties, Static CMOS Inverter, Static and Dynamic Power Dissipation, CMOS inverter delay time definitions and calculations

**Design of Combinational Logic Gates in CMOS:** Introduction, Static CMOS Design, Dynamic CMOS Design, Domino and NORA logic, Power Consumption in CMOS Gates.

**UNIT-II: DESIGN OF SEQUENTIAL LOGIC GATES IN CMOS (10 Periods)**

Introduction, Static Sequential Circuits, Dynamic Sequential Circuits, Non-Bistable Sequential Circuit, Logic Style for Pipelined Structures.

**Timing Issues in Digital Circuits:** Introduction, Clock Skew and Sequential Circuit Performance, Clock Generation and Synchronization.

**UNIT-III: HIGH SPEED NETWORK AND MEMORY DESIGN (09 Periods)**

Methods of Logical Effort for transistor sizing - Power consumption in CMOS Gates, Low power CMOS design. CMOS Memory design – SRAM, DRAM.

**UNIT-IV: SUBSYSTEM DESIGN PROCESS (09 Periods)**

General arrangement of 4-bit Arithmetic Processor, Design of 4-bit shifter, Design of ALU sub-system, Implementing ALU functions with an adder, Multipliers, modified Booth's algorithm.



**UNIT-V: DESIGN METHODOLOGY AND TOOLS****(08 Periods)**

Introduction, Structured Design Strategies, Design Methods, Design Flows, Design Economics, Data Sheets and Documentation.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Jan M Rabaey, "*Digital Integrated Circuits*", Pearson, 2<sup>nd</sup> Edition, 2016.
2. Kamran Eshraghian, Douglas A. Pucknell and Sholeh Eshraghian, "*Essential of VLSI Circuits and Systems*", PHI, 1st edition, 2005.

**REFERENCE BOOKS:**

1. Sung-Mo Kang & Yusuf Leblebici, "*CMOS Digital Integrated Circuits-II*", McGraw Hill, 3rd edition, 2003.
2. Neil H. E. Weste, David Money Harris, "*CMOS VLSI Design-A Circuit and Systems Perspective*", Pearson Education, 4th Edition, 2011.

**III B. Tech. – II Semester**  
**(19BT60406) SATELLITE COMMUNICATIONS**  
(Professional Elective- 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** Courses on Analog Communications and Digital Communications.

**COURSE DESCRIPTION:** Orbital Aspects; Satellite Subsystems; Satellite Link Design; Earth Station Technology; Multiple Access; Orbit Considerations; Global Positioning System.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Solve problems on satellite's orbital mechanics by analyzing various satellite orbits, launches, launch Vehicles, kepler's laws of planetary motion.
- CO2: Design efficient satellite uplink-downlink budgets for the given parameters by analyzing various subsystems of satellite such as Telemetry, Tracking and Command, Power, Altitude and Orbit control system.
- CO3: Apply appropriate multiple accessing techniques to enhance the performance of satellite systems such as FDMA, TDMA and CDMA techniques.
- CO4: Analyze various LEO, GEO & NGSO constellation satellites and their design aspects for various satellite applications.
- CO5: Analyze the principles of global positioning systems, GPS Receiver Operation and satellite based Navigation Services in India such as GAGAN (GPS Aided Geo Augmented Navigation) and IRNSS (Indian Regional Navigation Satellite System).

**DETAILED SYLLABUS :**

**UNIT-I: INTRODUCTION, ORBITAL MECHANICS AND LAUNCHERS (10 Periods)**

Origin of Satellite Communications, Historical Background, Basic Concepts of Satellite Communications, Frequency Allocations for Satellite Services, Applications, Future Trends of Satellite. Orbital Mechanics, Kepler's Laws of planetary motion, Look Angle Determination, Orbital Perturbations, Orbit Determination, Launches and Launch Vehicles, Orbital Effects in Communication Systems Performance.

**UNIT-II: SATELLITE SUBSYSTEMS AND SATELLITE LINK DESIGN (10 Periods)**

Satellite Subsystems - Attitude and Orbital Control System, Telemetry, Tracking, Command and Monitoring, Power Systems, Communication Subsystems, Satellite Antennas, Equipment Reliability and Space Qualification. Basic Transmission Theory, System Noise Temperature and G/T ratio, Design of Uplink and Down Links, Design of Satellite Links for specified C/N.

### **UNIT-III: EARTH STATION TECHNOLOGY AND MULTIPLE ACCESS (09 Periods)**

**EARTH STATION:** Introduction, Transmitters, Receivers, Antennas, Tracking Systems,  
**MULTIPLE ACCESS:** Frequency Division Multiple Access (FDMA), Intermodulation, Calculation of C/N, Time Division Multiple Access (TDMA) Frame Structure, DAMA, Code Division Multiple Access (CDMA), Spread Spectrum Transmission and Reception.

### **UNIT-IV: LOW EARTH ORBIT AND NON-GEOSTATIONARY SATELLITE SYSTEMS (08 Periods)**

Orbit Consideration, Coverage and Frequency Considerations, Delay and Throughput Considerations, System Considerations, Operational NGSO Constellation Designs and comparisons.

### **UNIT-V: THE GLOBAL POSITIONING SYSTEM AND SATELLITE NAVIGATION (08 Periods)**

**THE GLOBAL POSITIONING SYSTEM:** GPS Position Location Principles, GPS Receivers and Codes, Satellite Signal Acquisition, GPS Navigation Message, GPS Signal Levels, Timing Accuracy, GPS Receiver Operation, GPS C/A Code Accuracy.

**SATELLITE NAVIGATION:** Introduction to Satellite based Navigation Services in India: GAGAN (GPS Aided Geo Augmented Navigation) and IRNSS(Indian Regional Navigation Satellite System)

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. Timothy Pratt, Charles W Bostian and Jeremy E Allnutt, WSE, *Satellite Communications*, Wiley publications, 2<sup>nd</sup>Edition, 2003.
2. Dennis Roddy, *Satellite communications*, McGraw Hill, 4<sup>th</sup>Edition, 2009.

#### **REFERENCE BOOKS:**

1. Wilbur L.Pritchard, Henri G.Suyderhoud and Robert A. Nelson, *Satellite Communications Engineering*, Pearson Publications, 2<sup>nd</sup>Edition, 2008
2. D.C.Agarwal, *Satellite communications*, Khanna Publications, 7<sup>th</sup>Edition, 2009.

#### **ADDITIONAL LEARNING RESOURCES**

*Weblinks:*<https://www.isro.gov.in/applications/step-towards-initial-satellite-based-navigation-services-india-gagan-irnss>

**III B. Tech. – II Semester**  
**(19BT60407) IMAGE PROCESSING**  
(Professional Elective- 3)  
(Common to CSE, EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Digital Signal Processing.

**COURSE DESCRIPTION:** Image Fundamental, Image Transforms, Image enhancement in spatial and frequency domains, Restoration of images corrupted by noise, Image Compression models with coding, Segmenting images based on properties and Color image processing.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Apply various transformations on images by analyzing basic operations on images.

CO2: Apply various image enhancement techniques in spatial and frequency domains.

CO3: Apply restoration techniques based on noise models and degradation function to restore the images, pertaining to health and societal applications.

CO4: Analyze various coding techniques for compression to reduce redundancies in images.

CO5: Analyze various segmentation techniques on images for societal applications.

CO6: Analyze various color models for different types of images.

**DETAILED SYLLABUS:**

**UNIT-I: IMAGE FUNDAMENTALS (10 Periods)**

Fundamental steps in Image Processing, Image sampling & quantization, some basic relationships between pixels, Arithmetic operations, Logical operations, Spatial operations,

**IMAGE TRANSFORMS:** 2D-DFT, Walsh Transform, Hadamard Transform, Discrete Cosine Transform, Haar-Transform, Slant Transform and KL Transform, properties of image transforms.

**UNIT-II: IMAGE ENHANCEMENT (11 Periods)**

Basic Intensity transformation functions, Histogram processing, Fundamentals of Spatial Filtering, Smoothing spatial filters, Sharpening spatial filters, Combining spatial Enhancement methods.

Basics of filtering in frequency domain, Correspondence between filtering in the spatial and frequency domains, Image smoothing using frequency domain filters, Image sharpening using frequency domain filters, Homomorphic filtering.

**UNIT-III: IMAGE RESTORATION****(07 Periods)**

Image degradation/Restoration model, Noise models, Restoration in the presence of Noise only-spatial filtering - mean, order- statistic and adaptive filters. Estimating the degradation function, Inverse filtering, Weiner filtering, Constrained least squares filtering.

**UNIT-IV: IMAGE COMPRESSION****(08 Periods)**

Classification of redundancy in Images, Image Compression models, Run length coding, Arithmetic coding, Dictionary based compression, bit-plane coding, Transform based coding, Fidelity Criteria, JPEG 2000.

**UNIT-V: IMAGE SEGMENTATION AND COLOR IMAGE PROCESSING (09 Periods)**

Detection of discontinuities- Point, line and edge Detection. Thresholding- global thresholding, adaptive thresholding. Region based Segmentation. Color image fundamentals - RGB, HSI models, conversions, Pseudo Color Image Processing, Color transformations.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Rafael C. Gonzalez & Richard E. Woods, *Digital Image Processing*, Pearson Education, 4<sup>th</sup> Edition, 2018.
2. Anil K.Jain, *Fundamentals of Digital Image processing*, Prentice Hall, 2007.

**REFERENCE BOOKS:**

1. S Jayaraman, S Esakkirajan, T Veerakumar, *Digital Image Processing*, Tata McGraw Hill Education, Second Edition, 2020.
2. Vipula Singh, *Digital Image Processing with MATLAB & LabVIEW*, Elsevier, 2019.

**III B. Tech. – II Semester**  
**(19BT60408) NANOSTRUCTURES AND NANOTECHNOLOGY**  
 (Professional Elective- 3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Engineering Physics, Engineering Chemistry & Electronic Devices and Circuits.

**COURSE DESCRIPTION:** Nanostructures – Classification and Peculiarities, Characterization and Properties of Nanomaterials, Micro Electro-Mechanical Systems (MEMS) & Nano Electro-Mechanical Systems (NEMS), Carbon Nanotubes (CNT) – Properties and Synthesis, Interdisciplinary Applications of Nanomaterials.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the peculiarities of nanostructured materials, their characterization and properties to solve structural, mechanical and electrical problems in manufacturing Nanostructures.
- CO2: Apply physical techniques to fabricate nanostructured materials
- CO3: Analyze the chirality of carbon nanotube and synthesize for various applications.
- CO4: Identify the appropriate nanomaterial in Quantum Devices, Emitters, Photo electrochemical Cells, Photonic Crystals and Plasmon Waveguides for societal application.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO NANOSTRUCTURED MATERIALS (09 Periods)**

Gleiter's classification of nanostructured materials, Classification of nanostructures by dimensionality, Concept of "surface form engineering" in nanomaterial science, Extended internal surface, Increasing of surface energy and tension, Grain boundaries, Instability of 3D0 NSM due to grain growth.

**UNIT-II: CHARACTERIZATION OF NANOMATERIALS AND PROPERTIES**

**(11 Periods)**

Structural Characterization: X-ray diffraction (XRD), Scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Chemical Characterization: Optical spectroscopy, Electron spectroscopy, Ionic spectrometry, Physical Properties of Nanomaterials: Melting points and lattice constants, Mechanical properties, Optical properties Electrical conductivity.

**UNIT-III: NANOSTRUCTURES FABRICATION BY PHYSICAL TECHNIQUES**

**(09 Periods)**

Introduction, Lithography, Nanomanipulation and Nanolithography, Soft Lithography, Assembly of Nanoparticles and Nanowires, Other Methods for Microfabrication.

#### **UNIT-IV: CARBON NANOTUBES (CNT)–PROPERTIES AND SYNTHESIS**

**(08 Periods)**

Dimensions, Chirality, Material Properties, Mechanical Properties, Electrical Properties, Optical Properties, Thermal Properties, Nanotube Growth Methods, Chemical Vapor Deposition, Thermal Chemical Vapor Deposition, Applications

#### **UNIT-V: INTERDISCIPLINARY ARENA OF NANOMATERIALS**

**(08 Periods)**

Molecular Electronics and Nanoelectronics, Nanobots, Biological Applications of Nanoparticles, Catalysis by Gold Nanoparticles, Band Gap Engineered Quantum Devices, Nanomechanics Carbon Nanotube Emitters, Photoelectrochemical Cells, Photonic Crystals and Plasmon Waveguides.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. Pokropivny, Vladimir, RynnoLohmus, Irina Hussainova, Alex Pokropivny, and Sergey Vlassov, "*Introduction to nanomaterials and nanotechnology*", Tartu, Estonia: Tartu University Press, 2007.
2. Guozhong Cao and Ying Wang, "*Nanostructures and Nanomaterials: Synthesis, Properties, and Applications*", Imperial College Press, 2004.

#### **REFERENCE BOOKS:**

1. Bhushan, Bharat, "*Springer Handbook of Nanotechnology*", 2<sup>nd</sup> edition, 2006.
2. A I Gusev and A ARempel, "*Nanocrystalline Materials*", Cambridge International Science Publishing, 1<sup>st</sup> Indian edition, 2008.
3. Kamal K. Kar, "*Carbon Nanotubes: Synthesis, Characterization and Applications*", Research Publishing Services, 1<sup>st</sup> edition, 2011.

#### **ADDITIONAL LEARNING RESOURCES**

1. *Introduction to Nanotechnology*, [nanohub.org](http://nanohub.org)
2. <https://nptel.ac.in/courses/103103033/module9/lecture1.pdf>

**III B. Tech. – II Semester**  
**(19BT60409) TESTING AND TESTABILITY**  
(Professional Elective- 3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Linear and Digital IC Applications and VLSI Design.

**COURSE DESCRIPTION:** Need for Testing, Types of Testing, Fault Modeling, Test Methods for evaluation, Test Generation Algorithms, Delay Tests, IDDQ Tests, Ad-Hoc DFT Methods, Scan Based Designs, Built-In Self Test.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the importance of Testing, fault models and related theorems.
- CO2: Analyze various test methods, combinational and sequential circuit test generation Algorithms for Functional Verification of Digital Circuits.
- CO3: Analyze delay test algorithms and IDDQ test algorithms for at-speed testing of CMOS Integrated Circuits.
- CO4: Understand the concepts and architectures for Built-In Self Test to satisfy industry specifications.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO TESTING (09 Periods)**

Role of Testing, VLSI Technology Trends Affecting Testing, Types of Testing, Test Economics, Yield, Fault Modeling, Fault Equivalence, Fault Collapsing, Fault Dominance and Checkpoint Theorem.

**UNIT-II: TEST METHODS (10 Periods)**

Simulation for Design Verification and Test Evaluation, Algorithms for Fault Simulation – Serial, Parallel, Deductive, Concurrent Fault Simulations; Fault Sampling.

**UNIT-III: COMBINATIONAL AND SEQUENTIAL CIRCUIT TEST GENERATION (11 Periods)**

ATPG Algorithms – D-Algorithm, PODEM, FAN; Test Compaction, Time Frame Expansion Method – Nine-Value Algorithm; Simulation Based Sequential ATPG - CONTEST Algorithm.

**UNIT-IV: DELAY AND IDDQ TESTS (06 Periods)**

Delay Test – Path-Delay Test, Transition Faults, At-Speed Testing; IDDQ Test – Limitations, Delta IDDQ Testing, IDDQ Built-in Current Testing.



**UNIT-V: DESIGN FOR TESTABILITY****(09 Periods)**

Ad-Hoc DFT Methods, Full Scan Design, Partial Scan Design, Random Logic BIST – Test-per-Clock and Test-per-Scan BIST Systems; Boundary Scan Standard – TAP Controller and Port.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOK:**

1. Michael L. Bushnell, Vishwani D. Agrawal, "*Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits*", Kluwer Academic Publishers, Springer US, New York, 2006.

**REFERENCE BOOKS:**

1. Miron Abramovici, Melvin A. Breur, Arthur D. Friedman, "*Digital Systems Testing and Testable Design*", Wiley, Jaico Publishing House, 1<sup>st</sup> Edition, 2001.
2. Alfred L. Crouch, "*Design for Test for Digital ICs & Embedded Core Systems*", Pearson Education, 1<sup>st</sup> Reprint Edition, 2007.
3. Robert J. Feigate, Jr., Steven M. McIntyre, "*Introduction to VLSI Testing*", Prentice Hall, 1st Illustrated Edition, 1998.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.classcentral.com/course/swayam-digital-vlsi-testing-7956>

**III B. Tech. – II Semester**  
**(19BT60410) WIRELESS SENSOR NETWORKS**  
(Professional Elective- 3)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Analog Communications & Digital Communications.

**COURSE DESCRIPTION:** Wireless Sensor Networks (WSN) architecture, types, Quality measures of wireless channels, various MAC protocols, Sensor deployment and routing related protocols, congestion control and cross layer architectures in WSNs.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Analyze the Single node architecture, Sensor nodes and nodes mobility.

CO2: Analyze physical layer design issues of wireless sensor networks.

CO3: Develop the MAC and link layer protocols for efficient energy usage.

CO4: Build minimum path routing protocols and data aggregation schemes for efficient energy utilization.

CO5: Apply sensing models and cross layer approaches for coverage and performance of WSNs.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO WIRELESS SENSOR NETWORKS (10 Periods)**

Challenges for wireless sensor networks, Comparison of sensor network with ad-hoc network, Single node architecture - Hardware components, energy consumption of sensor nodes. Examples of sensor nodes - Mica Mote, EYES Nodes, BTnodes. Network architecture: Sensor network scenarios - types of sources and sinks, single hop versus multi-hop networks, multiple sinks and sources, Three types of mobility.

**UNIT-II: PHYSICAL LAYER (07 Periods)**

Introduction, wireless channel and communication fundamentals – frequency allocation, modulation and demodulation, Physical layer and transceiver design consideration in wireless sensor networks - Energy usage profile, choice of modulation, Antenna considerations.

**UNIT-III: DATA LINK LAYER (10 Periods)**

**MAC protocols:** fundamentals of wireless MAC protocols - Requirements and design constraints for wireless MAC protocols, Important classes of MAC protocols, MAC protocols for wireless sensor networks. Low duty cycle protocols and wakeup concepts - STEM, S-MAC. Contention-based protocols - CSMA protocols, PAMAS. Schedule-based protocols - LEACH, BMAC, Traffic-adaptive medium access protocol (TRAMA).

**Link Layer protocols** – fundamentals task and requirements, error control - Causes and characteristics of transmission errors, ARQ techniques.

**UNIT-IV: NETWORK LAYER****(09 Periods)**

Gossiping and agent-based uni-cast forwarding - Basic idea, Randomized forwarding. Energy-efficient unicast, Broadcast and multicast - Source-based tree protocols, Shared, core-based tree protocols. Mobile nodes - Mobile sinks, Mobile data collectors, Mobile regions. Data centric and content-based networking - Introduction, Data-centric routing, Data aggregation.

**UNIT-V: TRANSPORT LAYER AND CROSS LAYER DESIGN****(09 Periods)**

The transport layer and QoS in wireless sensor networks - Quality of service/reliability, Transport protocols. Coverage and deployment - Sensing models, Uniform random deployments: Poisson point processes, Reliable data transport. Congestion control and rate control - Congestion situations in sensor networks. The CODA congestion-control framework.

**Cross-Layer Design:** Definition, Cross-layer architectures for Sensor Networks: Sensor Protocol, TinyCubus, Lu.

**Total periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Holger Karl, Andreas willig "Protocol and Architecture for Wireless Sensor Networks", John wiley publication, Oct 2007.
2. Raja Jurdak, "Wireless Ad Hoc and Sensor Networks: A Cross-Layer Design Perspective", Springer Series, New York, 2007.

**REFERENCE BOOKS:**

1. Fengzhao, Leonidas, Guibas, "Wireless Sensor Networks: an information processing approach –publication, Elsevier, 2004.
2. Edgar H .Callaway,"Wireless Sensor Networks: Architecture and protocol", 1<sup>st</sup> Edition, CRC press 2003.
3. C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, "Wireless Sensor Networks", Springer publication, 2006.

**III B. Tech. –II Semester**  
**(19BT60502) MACHINE LEARNING**  
(Inter Disciplinary Elective- 2)  
(Common to CSE, CSSE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Concept learning, General to specific ordering, Decision tree learning, Support vector machine, Artificial neural networks, Multilayer neural networks, Bayesian learning, Instance based learning, reinforcement learning.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the concept learning algorithms to automatically infer a general description for a given learning problem.
- CO2: Analyze the underlying mathematical models within machine learning algorithms and learning tasks.
- CO3: Evaluate and apply suitable machine learning algorithms for various types of learning tasks.
- CO4: Design efficient neural architectures to model patterns for a given learning problem.
- CO5: Select and apply machine learning algorithms to solve societal problems such as face recognition, text classification.

**DETAILED SYLLABUS:**

**UNIT-I: CONCEPT LEARNING AND GENERAL-TO-SPECIFIC ORDERING**

**(09 Periods)**

Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning, Concept learning task, Concept learning as search, FIND-S, Versionspaces and candidate elimination algorithm, Inductive bias.

**UNIT-II: DECISION TREE LEARNING AND KERNEL MACHINES**

**(09 Periods)**

**Decision Tree Learning:** Decision tree representation, Problems for decision tree learning, Decision tree learning algorithm, Hypothesis space search, Inductive bias in decision tree learning, Issues in decision tree learning.

**Kernel Machines:** Support vector machines – SVMs for regression, SVMs for classification, Choosing C, A probabilistic interpretation of SVMs.

**UNIT-III: ARTIFICIAL NEURAL NETWORKS**

**(09 Periods)**

Neural network representations, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and Backpropagation algorithm, Convergence and local minima, Representational power of feedforward networks, Hypothesis space search and inductive bias, Hidden layer representations, Generalization, Overfitting, Stopping criterion, An Example -Face Recognition.

#### **UNIT-IV: BAYESIAN LEARNING**

**(10 Periods)**

Bayes theorem and concept learning, Maximum likelihood and least-squared error hypothesis, Maximum likelihood hypotheses for predicting probabilities, Minimum Description Length principle, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier, An Example – Learning to classify text; Bayesian belief networks, EM algorithm.

#### **UNIT-V: INSTANCEBASED LEARNING AND REINFORCEMENT LEARNING**

**(08 Periods)**

**Instance Based Learning:** k-Nearest Neighbor learning, Locally weighted regression, Radial basis functions, Case-based reasoning.

**Reinforcement Learning:** The learning task, Q-learning, Nondeterministic rewards and actions, Temporal difference learning, Generalizing from examples, Relationship to dynamic programming.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

#### **TEXT BOOKS:**

1. Tom M. Mitchell, *Machine Learning*, McGrawHill, 2013.
2. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.

#### **REFERENCE BOOKS:**

1. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press, 4<sup>th</sup> Edition, 2020.
2. Shai Shalev Shwartz, Shai Ben David, *Understanding Machine Learning: From Theory to Algorithms*, Cambridge University Press, 2014.

#### **ADDITIONAL LEARNING RESOURCES:**

- [https://swayam.gov.in/nd1\\_noc19\\_cs52/preview](https://swayam.gov.in/nd1_noc19_cs52/preview)
- <https://www.udemy.com/course/machinelearning/>

**III B. Tech. – II Semester**  
**(19BT60201) POWER ELECTRONICS**

(Inter Disciplinary Elective- 2)

(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Electronic Devices and Circuits.

**COURSE DESCRIPTION:** Power semiconductor devices; Silicon Controlled Rectifier — Turn-on methods, Triggering and commutation circuits for SCR; Single phase and three phase controlled rectifiers; Choppers; AC voltage controllers and Cyclo-converters; Inverters.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the switching operations/characteristics of uncontrolled, semi-controlled and fully controlled power semiconductor devices.
- CO2: Analyze commutation circuits, buck and boost operations of DC-DC converters circuit for different duty cycles.
- CO3: Analyze AC-DC, AC-AC and dual converters circuit operation and evaluate their output parameters for R & RL loads with different firing pulses.
- CO4: Analyze the conduction modes and PWM techniques of DC-AC converters circuit by single phase or three phase topologies.

**DETAILED SYLLABUS:**

**UNIT-I: POWER SEMICONDUCTOR DEVICES (11 Periods)**

Introduction to power electronics, Power diode — switching characteristics. Power transistors — power BJT, power MOSFET, IGBT and their characteristics; Thyristor — basic theory and operation, static and dynamic characteristics; two transistor analogy, turn-on methods, UJT firing circuits, series and parallel operation; protection against  $dv/dt$  and  $di/dt$ , design of snubber circuit.

**UNIT-II: PHASE CONTROLLED RECTIFIERS (11 Periods)**

Single phase controlled rectifiers — half wave controlled rectifier, bridge connections semi and fully controlled rectifiers with R and RL loads, derivation of average load voltage and current, effect of freewheeling diode; effect of source inductance; Three phase controlled rectifiers — half and fully controlled rectifiers-midpoint connection with R load, Bridge connections with R and RL loads, derivation of average load voltage and current.

**UNIT-III: COMMUTATION CIRCUITS AND CHOPPERS (07 Periods)**

Thyristor forced commutation circuits; Chopper — step-down and step-up operation, control strategies, derivation of load voltage with R load. Load commutated chopper.

#### **UNIT-IV: DUAL CONVERTERS & AC VOLTAGE CONTROLLERS (07 Periods)**

Dual converters — circulating and non-circulating current modes of operation of single phase and three phase dual converters with R-Load; Single phase AC voltage controllers — two SCRs in anti-parallel with R and RL loads, derivation of RMS load voltage and load current; Cyclo-converters — single phase midpoint and bridge type (step-up and step-down operations) with R and RL loads.

#### **UNIT-V: INVERTERS (09 Periods)**

Single phase inverters — basic operation, voltage source inverters, current source inverter and basic series & parallel inverters. Voltage control by pulse width modulation techniques — single pulse, multiple pulse and sinusoidal PWM techniques; Three phase bridge Inverters — 180° and 120° conduction modes of operation.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. Dr. P. S. Bimbhra, *Power Electronics*, Khanna Publishers, 6<sup>th</sup> Edition, Delhi, 2018.
2. M. D. Singh & K. B. Kanchandhani, *Power Electronics*, TataMcGraw - Hill Publishing Company, 2013.

#### **REFERENCE BOOKS:**

1. Mohan, Undeland, Robbins, *Power Electronics: Converters, Applications and Design*, 3<sup>rd</sup> Edition, Wiley, 2007.
2. Muhammad H. Rashid, *Power Electronics – Devices, Circuits and Applications*, 4<sup>th</sup> Edition, Pearson, 2017.

#### **ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/108/102/108102145/>
2. <https://nptel.ac.in/courses/108/101/108101126/>
3. <https://nptel.ac.in/courses/108/101/108101038/>
4. <https://nptel.ac.in/courses/108/107/108107128/>

**III B. Tech. – II Semester**  
**(19BT60503) CRYPTOGRAPHY AND NETWORK SECURITY**

(Inter Disciplinary Elective- 2)

(Common to CSE and ECE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on "Computer Networks"

**COURSE DESCRIPTION:** Concepts of cryptographic algorithms, Substitution techniques, Symmetric ciphers, Block cipher operations, Cryptographic data integrity algorithms, Key management and distribution, User authentication, Transport level security, Electronic mail security, IP security.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the knowledge of concepts of network security, symmetric and public key cryptosystems to identify the potential threats in networks.
- CO2: Analyze hash functions, message authentication codes, digital signatures for providing data integrity in information security applications.
- CO3: Use key management and distribution techniques, user authentication techniques for assuring mutual trust among users.
- CO4: Demonstrate knowledge on network and Internet security techniques for addressing the security threats.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION (9 Periods)**

Computer security concepts, Security attacks, Security services, Security mechanisms, Model for network security, Symmetric cipher model, Substitution techniques - Monoalphabetic ciphers and Polyalphabetic ciphers.

**UNIT-II: SYMMETRIC CIPHERS (7 Periods)**

Stream ciphers and block ciphers, Data Encryption Standard(DES), Advanced Encryption Standard (AES) - Structure, Transformation Functions; Block Cipher Operation - Multiple encryption and triple DES, Cipher block chaining mode, Cipher feedback mode, Output feedback mode, Counter mode.

**UNIT-III: PUBLIC KEY CRYPTOGRAPHY AND CRYPTOGRAPHIC DATA INTEGRITY ALGORITHMS (9 Periods)**

**Public Key Cryptography:** RSA, Diffie-Hellman key exchange, Elgamal cryptographic system.

**Cryptographic Data Integrity Algorithms:** Hash Functions - Simple hash functions, Secure Hash Algorithm SHA-512; Message Authentication Codes- Requirements, Functions, Security of MACs, HMAC; Digital signatures- Schnorr Digital signature scheme;



**UNIT-IV: MUTUAL TRUST****(10 Periods)**

**Key Management and Distribution:** Symmetric key distribution using symmetric and asymmetric encryption, Distribution of public keys, X.509 certificates, Public key infrastructure.

**User Authentication:** Remote user authentication principles, Kerberos, Personal identity verification.

**UNIT-V: NETWORK AND INTERNET SECURITY****(10 Periods)**

**Transport Level Security:** Web security considerations, Transport layer security, HTTPS.

**Electronic Mail Security:** S/MIME, Pretty Good Privacy, DNSSEC.

**IP Security:** Overview, Policy, Encapsulating security payload.

**Total Periods: 45**

**Topics for self study are provided in lesson plan**

**TEXT BOOK:**

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, 8<sup>th</sup> Edition, Pearson, 2020.

**REFERENCE BOOKS:**

1. William Stallings, *Network Security Essentials: Applications and Standards*, 6<sup>th</sup> Edition, Pearson, 2018.
2. Douglas R. Stinson, Maura B. Paterson, *Cryptography: Theory and Practice*, 4<sup>th</sup> Edition, CRC Press, 2018.
3. Atul Kahate, *Cryptography and Network Security*, 3<sup>rd</sup> Edition, McGraw Hill, 2017.

**ADDITIONAL RESOURCES**

- <https://nptel.ac.in/courses/106105031/>
- <https://www.udemy.com/introduction-to-cryptography-online-course-rahsoft-crypto-certificate/>
- <https://www.coursera.org/learn/asymmetric-cryptography>
- <https://www.khanacademy.org/computing/computer-science/cryptography>

**III B. Tech. - II Semester**  
**(19BT51041) PLC AND SCADA**  
(Inter Disciplinary Elective- 2)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** A course on Switching Theory and Logic Design.

**COURSE DESCRIPTION:** Introduction to PLC, PLC ladder diagrams, programming on PLC, timers, counters and sequences used in PLC, Display Conventions and Navigation, Remote Terminal Units, Master Terminal Units, SCADA Works Station Application Programmes.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on programmable logic controllers and various functions of PLCs.
- CO2: Develop PLC program, to solve various problems in process industries.
- CO3: Demonstrate knowledge on various elements of SCADA Software.
- CO4: Analyse the industrial process by using various displays in SCADA software and provide appropriate solutions.

**DETAILED SYLLABUS:**

**UNIT-I: PLC BASICS AND PROGRAMMING (10 Periods)**

Introduction, PLC system, CPU, I/O modules and interfacing, power supplies, Programming equipment, Programming formats, Construction of PLC ladder diagrams, Devices connected to I/O modules. Input instructions, Outputs, Operational procedures.

**UNIT-II: LADDER DIAGRAMS, REGISTERS AND TIMER FUNCTIONS (10 Periods)**

Digital logic gates, Boolean algebra PLC programming, Fail-Safe Circuits, characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers. Timer function, Counter function & industrial applications.

**UNIT-III: INTERMEDIATE AND DATA HANDLING FUNCTION (09 Periods)**

Intermediate functions: Arithmetic functions, Number comparison functions, Number conversion functions. Skip, Master control relay, Jump functions, Sequencer functions and applications, Controlling of two-axis & three axis Robots with PLC, Matrix functions.

**UNIT-IV: The Elements of SCADA Software (10 Periods)**

SCADA System Architecture - Field Devices and Signals, Programmable Process Controller, Communication Network, Central Control Facilities, Display Conventions and Navigation. Remote Terminal Units-Discrete control, analog control, Monitor discrete signals, monitor analog signals. Master terminal Units.

## **UNIT-V: SCADA WORKS STATION APPLICATION PROGRAMME (06 Periods)**

Identifying the process areas, configuring HMI applications. Process Graphic Displays- Current Process Operations, Equipment Control Displays, Alarm and Event Summaries, Trends and Historical Reports, Maintenance Displays. Configuration of I/O Server, System graphic displays Sample Application: Water Treatment Plant SCADA System.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

### **TEXT BOOKS:**

1. John W. Webb & Ronald A. Reiss, *Programmable Logic Controllers Principles and Applications*, 5<sup>th</sup> edition, PHI, 2009.
2. Stuart G. Mc. Crady, *Designing SCADA Application Software A Practical Approach*, 1<sup>st</sup> Elsevier, 2013.

### **REFERENCE BOOKS:**

1. Frank D. Petruzella, *Programmable Logic Controller*, 3<sup>rd</sup> edition, Tata McGraw-Hill Edition 2010.
2. Stuart A. Boyer, *Supervisory Control and Data Acquisition*, 3<sup>rd</sup> edition, ISA 2004.

### **WEBLINKS:**

1. <https://openautomationsoftware.com/use-cases/allen-bradley-wpf-scada/>
2. <https://new.siemens.com/global/en/products/automation/industry-software/automation-software/scada.html>
3. <https://ab.rockwellautomation.com/Programmable-Controllers>
4. <https://en.wikipedia.org/wiki/SCADA>
5. <http://www.isa.org>
6. <http://www.controleng.com>
7. <http://literature.rockwellautomation.com>
8. <http://www.automation.siemens.com>

### III B. Tech. – II Semester

#### (19BT60431) **DIGITAL SIGNAL PROCESSING LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A Course on Digital Signal Processing.

**COURSE DESCRIPTION:** Implementation of Convolution; DFT and FFT; Design of Analog, Digital FIR and IIR filters.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Analyze the response of LTI systems using linear and circular convolutions.

CO2: Analyze the spectrum of Discrete and analog signals using frequency Transformation techniques.

CO3: Design Analog filters and Digital FIR & IIR filters using transformation and Windowing techniques.

CO4: Work independently and in teams to solve problems with effective Communication.

#### **List of Exercises/List of Experiments:**

- 1 Verify linear convolution of aperiodic sequences using CCS on DSP processors and also verify using MATLAB.
- 2 Verify the circular convolution on Periodic sequences using CCS on DSP processors and also verify using MATLAB.
- 3 Verify N-point DFT & IDFT using CCS on DSP processors and also verify using MATLAB.
- 4 Verify N-point FFT algorithm using CCS on DSP processors and also verify using MATLAB.
- 5 Find the frequency response of analog Butterworth prototype filters (LP/HP/BP/BR) using MATLAB.
- 6 Find the frequency response of analog chebyshev prototype filters (LP/HP/BP/BR) using MATLAB.
- 7 Design FIR filter (LP/HP/BP/BR) using following windowing techniques with MATLAB
  - A) rectangular window
  - B) triangular window
- 8 Design FIR filter (LP/HP/BP/BR) using following windowing technique with MATLAB
  - A) Hamming window
  - B) Hanning window
  - C) Blackman window
- 9 Design FIR filter (LP/HP/BP/BR) using Kaiser window with MATLAB.
- 10 Implement IIR Butterworth filter (LP/HP/BP/BR) using bilinear transformation techniques with MATLAB.
- 11 Implement IIR Chebyshev filter (LP/HP/BP/BR) using impulse-invariance transformation techniques with MATLAB.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Vinay K. Ingle, John G. Proakis, "Digital Signal Processing Using MATLAB", Cengage Learning, Third Edition, 2012.
2. Emmanuel C. Ifeachor & Barrie. W. Jervis, "*Digital Signal Processing*," Pearson Education / Prentice Hall, Second Edition, 2002.
3. S. K. Mitra, "Digital Signal Processing: A computer based approach", McGraw Hill, 2011.

**SOFTWARE/Tools used:**

- MATLAB
- Code Composer Studio

**ADDITIONAL LEARNING RESOURCES:**

<http://vlabs.iitkgp.ac.in/dsp/>

**III B. Tech. - II semester**  
**(19BT60432) MICROCONTROLLERS LAB**  
(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** Courses on Switching Theory and Logic Design & Linear and Digital IC Applications

**COURSE DESCRIPTION:** PIC Microcontrollers; Interfacing standard peripherals & Programming DAC, Stepper Motor, ADC, DAC, Keyboard, Seven Segment Display & Serial Communication.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Analyze the instruction set to program 8051 for control applications.

CO2: Analyze the instruction set to program PIC18 for computing applications.

CO3: Develop Programs using on chip resources and interface external components such as LCD, Keypad, and Motors for societal needs.

CO4: Work independently and in teams to solve problems with effective Communication.

**LIST OF EXPERIMENTS: (Minimum Twelve experiments to be conducted)**

**PART: A (Programs using 8051)**

1. Arithmetic operations using internal and external memory.
2. Programs using special instructions like SWAP, bit/byte, set/ reset etc.
3. Bank Switching & Branch operations

**PART: B (Programs using PIC Microcontroller)**

1. Arithmetic operations.
2. Logical & Branch operations
3. Bit manipulation operations.
4. Macros & Modular programming.
5. Time Delay programs.

**PART: C (Interfacing with PIC microcontrollers)**

1. Interface switches, LEDs, 7-segment display.
2. Interfacing of PIC18 with Keyboard and LCD.
3. Interfacing of PIC18 with DAC.
4. Interfacing using serial communication & DC Motor
5. Interfacing Stepper Motors

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D, *The 8051 Microcontroller and Embedded Systems-using assembly and C*, PHI, 2006/ Pearson 2008
2. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny causey, *PIC Microcontroller and Embedded Systems: Using C and PIC18*, Pearson Education, 2015.

**III B. Tech. - II semester**  
**(19BT60433) SOCIALLY RELEVANT PROJECT-II**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | - | 1 |

**PREREQUISITES:** -

**COURSE DESCRIPTION:**

Identification of topic for the socially relevant project; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the socially relevant project; Preparation of thesis and presentation.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Create/Design engineering systems or processes to solve complex societal problems using appropriate tools and techniques following relevant standards, codes, policies, regulations and latest developments.
- CO2: Consider environment, sustainability, economics and project management in addressing societal problems.
- CO3: Perform individually or in a team besides communicating effectively in written, oral and graphical forms on socially relevant project.



**III B. Tech. - II semester**  
**(19BT5MC01) UNIVERSAL HUMAN VALUES**

(Mandatory Course)

(Common to CE, ME, EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | -          | 40          | 2 | - | - | - |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Process for Value Education; Harmony in the Human Being - Harmony in Myself!; Harmony in Family and Society- Human Relationship; Harmony in the Nature and Existence – Coexistence; Implications of Holistic Understanding of Harmony on Professional Ethics.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Understand Values and skills for sustained happiness and prosperity.

CO2: Analyse realistic implications of a Holistic understanding of ethical human conduct, trustful and mutually fulfilling human behaviour.

CO3: Apply holistic approach in personal life and profession through a positive understanding of the Human reality and existence.

**DETAILED SYLLABUS:**

**UNIT-I: VALUE EDUCATION (06 Periods)**

Human Values-Introduction; Self-Exploration - Natural Acceptance; Human Aspirations- Right understanding- the current scenario: understanding and living in harmony.

**UNIT-II: HUMAN BEING AND SELF (06 Periods)**

Understanding human being - I' and the material 'Body'; needs of Self ('I') and 'Body'- happiness and physical facility; Body as an instrument of 'I' - characteristics and activities of 'I' and harmony in 'I'; harmony of I with the Body.

**UNIT-III: FAMILY, THE SOCIETY AND THE NATIONS (06 Periods)**

Values in human relationship (nine universal values) - foundational values of relationship; Difference between intention and competence; Difference between respect and differentiation; harmony in the society; Universal harmonious order in society.

**UNIT-IV: HARMONY WITH THE NATURE (06 Periods)**

Harmony in the Nature; Interconnectedness and mutual fulfilment - the four orders of nature - Recyclability and Self-regulation; Existence as Co-existence; Holistic perception of harmony and existence.

**UNIT-V: HARMONY WITH PROFESSIONAL ETHICS****(06 Periods)**

Acceptance of human values; Ethical Human Conduct; Basis for Humanistic Education; Competence in professional ethics; Case studies: Holistic technologies, Management Models and Production Systems; Socially and ecologically responsible engineers, technologists and managers - enriching institutions and organizations.

**Total Periods: 30*****Topics for Self-Study are provided in the Lesson Plan*****TEXT BOOK:**

1. R R Gaur, R Sangal, G P Bagaria, *Human Values and Professional Ethics*, Excel Books, New Delhi, 2010

**REFERENCE BOOKS:**

1. JeevanVidya: EkParichaya, A Nagaraj, JeevanVidya Prakashan, Amarkantak, 1999.

**IV B. Tech. - I Semester**  
**(19BT6HS02) ORGANIZATIONAL BEHAVIOR**  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to organizational Behavior; Individual behavior and Personality; Interpersonal and group behavior; Leadership; Organizational change and development

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Equip with basic idea on concepts and skills of organizational behavior.
- CO2: Demonstrate the applicability of the concept of organizational behavior to understand the behavior of people in the organization
- CO3: Analyze the complexities associated with management of the individual, group behavior in the organization.
- CO4: Develop leadership qualities
- CO5: Improve individual behavior, skill and life-long learning in a group.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO ORGANIZATIONAL BEHAVIOR (09 Periods)**

Meaning and Definition, Nature, Scope, Features, Significance of Organizational Behavior – Levels and Contributing disciplines to OB – Emerging Issues and Challenges of OB

**UNIT-II: INDIVIDUAL BEHAVIOR AND PERSONALITY (09 Periods)**

**INDIVIDUAL:** Introduction – Role of Brain and Mind in Individual Behavior – Similarities and Dissimilarities in Individuals – Reasons for individual differences – Nature of Man – Models of man – Values, Attitudes, emotions, Moods and Job satisfaction.

**PERSONALITY:** Introduction – Personality Traits – Determinants of Personality – Personality Theories.

**UNIT-III: INTERPERSONAL AND GROUP BEHAVIOR (09 Periods)**

**INTRODUCTION TO INTERPERSONAL:** Process of perception – Inter personal perception

**GROUP BEHAVIOR:** Meaning and Definition of a Group – Classification of Groups – Stages of Group development.

**UNIT-IV: LEADERSHIP (09 Periods)**

Meaning and Definition of Leadership – Leadership Theories: Behavioral Theories and Modern theories – Leadership Styles – New directions for leadership

**UNIT-V: ORGANIZATIONAL CHANGE AND DEVELOPMENT****(09 Periods)**

Meaning – Nature of work change – Pressure for change – Change Process – Types of change – Factors influencing change – Organizational development process – OD interventions/Techniques.

**Total Periods: 45*****Topics for Self-Study are provided in the Lesson Plan*****TEXT BOOKS:**

1. Stephen P. Robbins, Timothy A. Judge and Neharika Vohra, *Organizational Behavior*, Pearson, Noida, 16<sup>th</sup> edition, 2017.
2. P.Subba Rao, *Management and Organizational behavior*, Himalaya Publishing House, Mumbai, Re-print 2019.

**REFERENCE BOOKS:**

1. Fred Luthans, *Organizational behavior*, McGraw Hill Higher Education, 10<sup>th</sup> edition, 2016.
2. Shashi K. Gupta and Rosy Joshi, *Organizational Behavior*, Kalyani Publications, 8<sup>th</sup> edition, 2017.

**IV B. Tech. - I Semester**  
**(19BT70401) EMBEDDED SYSTEMS**  
(Common to EEE, ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Switching Theory and Logic Design, Linear and Digital IC Applications & Microcontrollers.

**COURSE DESCRIPTION:** MSP430 Architecture; Instruction Set; Programming; On-Chip Resources; Communication with peripherals; Embedded system design approaches.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze MSP430 Architecture, Instruction Set, Addressing modes to develop programs for various control applications using Assembly and Embedded C.
- CO2: Solve Problems by analyzing MSP430 On Chip Resources such as Timer, Clock System, Low Power Modes/techniques and Interrupt Structure.
- CO3: Realize Mixed Signal Processing and Networking Applications, by analyzing on-Chip Resources such as Comparator, ADC, Temperature Sensor, PWM and Communication Peripherals.
- CO4: Analyze Language, IDE Support, Processor IC & Design Technologies, and System Modeling Techniques to capture behavior of Embedded Prototype using suitable model.

**DETAILED SYLLABUS:**

**UNIT-I: ARCHITECTURE OF MSP430 (09 Periods)**

Embedded Systems – Introduction, MSP430 - Anatomy of microcontroller, Memory, Software, Pin out (MSP430G2553), Functional Block diagram, Memory, CPU, and Memory mapped input and output, Clock generator; Exceptions- Interrupts and Resets.

**UNIT-II: PROGRAMMING MSP430 (09 Periods)**

Development Environment, Aspects of C for Embedded Systems, Assembly Language, Register Organization, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Example programs- Light LEDs, Read input from a switch; Automatic Control-Flashing light by delay, use of subroutines and Functions; Basic Clock System, Interrupts and Low Power Modes.

**UNIT-III: TIMERS AND MIXED SIGNAL SYSTEMS (09 Periods)**

Timers - Watchdog Timer, RTC, Timer\_A, Measurement in capture mode, PWM generation;

Mixed Signal Systems- Comparator\_A, ADC10 SAADC –Architecture, operation- Single Conversion, Temperature Sensor on ADC10, DTC in ADC10; ADC12 – Comparison with ADC10.

**UNIT-IV: COMMUNICATION PERIPHERALS & PROTOCOLS****(09 Periods)**

MSP430 Communication Interfaces- USART,USCI, USI;

Communication Protocols- SPI, Inter-integrated Circuit Bus, USB, CAN

**UNIT-V: EMBEDDED SYSTEM DESIGN****(09 Periods)**

Processor Technology, IC Technology, Design Technology, Tradeoffs.

Model VS.Language, System Modelling – Data Flow Model, FSM, FSMD, HCFSM, PSM, Concurrent Process Model & implementation.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. John H. Davies, *MSP430 Microcontroller Basics*, Newnes Publications, 1<sup>st</sup> Edition, 2008.
2. Santanu Chattopadhyay, *Embedded System Design*, PHI, 2010.
3. Frank Vahid, Tony D. Givargis, *Embedded System Design – A Unified Hardware/Software Introduction*, John Wiley, January 2006

**REFERENCE BOOKS:**

1. Chris Nagy, *Embedded Systems Design using the TI MSP30 Series*, Newnes Publications, October 2003.
2. JorgeonStaunstrup, Wayne Wolf, *Hardware/Software Co-design Principles and Practice*, Springer 2009.
3. Patrick R Schamont, *A Practical Introduction to Hardware/Software Co-design*, Springer publications, January 2010

**IV B. Tech. - I Semester**  
**(19BT70402) MICROWAVE ENGINEERING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** A course on Electromagnetic Fields and Transmission Lines.

**COURSE DESCRIPTION:** Wave Propagation; Waveguide components; Microwave tubes; Microwave solid state devices; and Microwave measurements.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze Waveguides as alternatives to transfer power at microwave frequencies.
- CO2: Design microwave components using waveguides to analyze the Performance of microwave networks.
- CO3: Analyze the Performance of microwave sources and solid state devices for high frequency radio applications.
- CO4: Evaluate power, attenuation, frequency, VSWR and impedance by various measurement methods for industrial and societal applications.

**DETAILED SYLLABUS:**

**UNIT-I: WAVEGUIDES (10 Periods)**

Introduction, Microwave spectrum and bands, applications of Microwaves; Rectangular Waveguides-solution of wave Equation in Rectangular Coordinates, TE and TM mode analysis, Expressions for fields, Characteristic equation and cutoff frequencies, Filter characteristics, Dominant and degenerate modes, sketches of TE and TM mode fields in the cross section; Mode characteristics – phase and Group velocities, wavelengths and impedance relations, Power Transmission and Power Losses, Illustrative Problems.

**UNIT-II: MICROWAVE COMPONENTS (10 Periods)**

Scattering Matrix- Significance, Formulation and properties. S Matrix calculations for 2-port junction, Waveguide multiport junctions-E plane and H plane Tees, Magic Tee, Directional coupler; Ferrites- composition and characteristics, faraday rotation, ferrite components – Isolator and Circulator. Waveguide Discontinuities – Waveguide Windows, Tuning Screws and Posts, Matched Loads. Coupling mechanisms- probe, loop. Waveguide attenuators- resistive card, rotary vane Attenuators, Waveguide phase shifters – dielectric and rotary vane types, Illustrative problems.

**UNIT-III: MICROWAVE SOURCES (12 Periods)**

Limitations and losses of conventional tubes at microwave frequencies. Classification of Microwave tubes. Two cavity klystron (Only Qualitative Treatment). Reflex Klystrons-structure, Velocity Modulation, Applegate diagram, mathematical theory of bunching, power output, efficiency, oscillating modes and O/P characteristics. Slow wave structures; structure of Helix TWT and amplification process. Magnetrons - different types, cylindrical travelling wave magnetron – Hull cutoff and Hartree conditions, Illustrative Problems.

**UNIT-IV: MICROWAVE SOLID STATE DEVICES****(08 Periods)**

Introduction, classification, applications, Transfer Electronic Devices, Gunn diode – RWH theory, Characteristics, basic modes of operation – Gunn oscillation modes, LSA Mode; Transit-Time Devices – IMPATT, TRAPATT and BARITT.

**UNIT-V: MICROWAVE MEASUREMENTS and MODERN TRENDS****(05 Periods)**

**MEASUREMENTS:** Description of Microwave Bench – different blocks and their features, errors and precautions; Microwave power measurement- Bolometer method, Measurement of attenuation, frequency, low and high VSWR, Q of the cavity and impedance measurements.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Samuel Y. Liao, *Microwave devices and circuits*, Pearson Education, 3rd Edition, 2003.
2. M.Kulkarni, *Microwave and Radar Engineering*, Umesh Publications, 5<sup>th</sup> Edition, 2016.

**REFERENCE BOOKS:**

1. F.E. Terman, *Electronic and Radio Engineering*, McGraw-Hill, 4th Edition, 1955.
2. Sushrut Das, *Microwave Engineering*, Oxford University Press, 2014.



**IV B. Tech. – I Semester**  
**(19BT71001) BIOMEDICAL INSTRUMENTATION**

(Professional Elective - 4)

(Common to ECE and EIE)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITE: -**

**COURSE DESCRIPTION:** Human Anatomy & Physiology; Bio-signals; Cardiovascular and Neuro-muscular Instrumentation; Therapeutic Equipment; Advanced Imaging techniques.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on Bioelectric Potentials and various electrodes for measuring Potentials.
- CO2: Analyze ECG signals and measure various cardiovascular parameters.
- CO3: Analyze EEG and EMG signals and measure various parameters in neuro muscular and respiratory systems.
- CO4: Demonstrate the working of various therapeutic instruments.
- CO5: Demonstrate the working of imaging instruments used for diagnosis by following ethical values.

**UNIT-I: BIO ELECTRIC POTENTIALS AND ELECTRODES (09 Periods)**

Block diagram of biomedical instrumentation, Problems encountered in measuring a living system, system, Structure of cell, Resting and Action Potentials, Propagation of Action Potentials, sources of Bioelectric Potentials, Electrode theory, Bio potential electrodes, Bio chemical transducers.

**UNIT-II: CARDIOVASCULAR INSTRUMENTATION (09 Periods)**

Physiology of cardiovascular system, electrical conduction system of the heart, interpretation of ECG waveform, standard 12-lead configurations, Einthoven triangle, specifications of ECG Machine; Blood pressure, blood flow and heart sound measurements; Relation between electrical and mechanical activities of the heart.

**UNIT-III: NEURO-MUSCULAR AND RESPIRATORY INSTRUMENTATION**

**(09 Periods)**

Physiology of nervous system, electrode placement for EEG and EMG recording, Specification of EEG and EMG machines, Interpretation of EEG and EMG.

Respiratory Instrumentation: Mechanism of respiration, Spirometry, Pneumotachograph Ventilators.

**UNIT-IV: THERAPEUTIC EQUIPMENT****(09 Periods)**

Pacemakers: Need for Cardiac pacemakers, pacing modes, Ventricular asynchronous Pacemaker (Fixed rate Pacemaker), Ventricular inhibited Pacemaker (demand Pacemaker), Atrial Synchronous pacemaker, Comparison between internal & external Pacemakers; Defibrillators: AC Defibrillator, DC Defibrillator, Synchronised DC Defibrillator; Diathermy: Shortwave and microwave, Dialysis: Hemo Dialysis, Peritoneal Dialysis.

**UNIT-V: MEDICAL IMAGING SYSTEM****(09 Periods)**

Ultrasonic Imaging: Doppler principle, Modes of Display: A-Mode, B-Mode and Echocardiography. Computed Tomography: Block diagram of CT scanner, Applications of Computed Tomography. MRI Imaging System, Cine angiogram, Endoscope.

**Total Periods: 45*****Topics for Self-Study are provided in the Lesson Plan*****TEXTBOOKS:**

1. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "*Biomedical Instrumentation and Measurements*", 2nd Edition, PHI, 2003.
2. R.S. Khandpur, "*Hand Book of Biomedical Instrumentation*", Tata McGraw Hill, 2nd Edition, 2002.

**REFERENCES:**

1. John G. Webster, "*Medical Instrumentation Application and Design*", 3<sup>rd</sup> Edition, Wiley India Pvt. Ltd., 2004
2. M. Arumugam, "*Biomedical Instrumentation*", Anuradha Publications, 1992.

**ADDITIONAL LEARNING RESOURCES:**

- <https://www.nibib.nih.gov/science-education/students-resource>
- [https://www.who.int/medical\\_devices/support](https://www.who.int/medical_devices/support)
- <https://nptel.ac.in>

**IV B. Tech. – I Semester**  
**(19BT70403) ANALOG IC DESIGN**  
(Professional Elective - 4)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Electronic Devices and Circuits & Electronic Circuits analysis and design

**COURSE DESCRIPTION:** MOS Device Physics, Single Stage Amplifiers, Differential Amplifiers, Current Mirrors, Operational Amplifiers, Frequency Compensation, Bandgap Reference circuits.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Analyze small signal Models and layout considerations of MOS devices.

CO2: Analyze Single Stage Amplifiers, Differential Amplifiers and Current Mirrors.

CO3: Apply gain boosting techniques, frequency compensation techniques to achieve stability in operational amplifiers.

CO4: Analyze the bandgap reference circuits to meet the optimal solutions.

**DETAILED SYLLABUS:**

**UNIT-I: BASIC MOS DEVICE PHYSICS (09 Periods)**

The MOSFET – Structure, Symbol, Switch operation, MOS I/V Characteristics, Second Order Effects, MOS Device Models – Layout, Capacitances, Small – Signal Model, SPICE Models, NMOS versus PMOS Devices, Long Channel versus Short Channel Devices.

**UNIT-II: SINGLE STAGE AMPLIFIERS (07 Periods)**

General Considerations, Common Source Stage with different loads, Source Follower, Common – Gate Amplifier, Cascode Stage – Folded Cascode Stage.

**UNIT-III: DIFFERENTIAL AMPLIFIERS AND CURRENT MIRRORS (11 Periods)**

Single ended and Differential Operation, Basic Differential pair, Common Mode Response, Basic Current Mirrors, Cascode Current Mirrors, Active Current Mirrors.

**UNIT-IV: OPERATIONAL AMPLIFIERS AND COMPENSATION (10 Periods)**

General Considerations, One-Stage Op-Amps, Two-Stage Op-Amps, Gain Boosting Techniques, Stability and Frequency Compensation – General Considerations, Multipole Systems, Phase Margin, Basic Frequency Compensation, Compensation of Two-Stage Op-Amps.

**UNIT-V: BANDGAP REFERENCES****(08 Periods)**

Bandgap References: Supply-Independent Biasing, Temperature-independent References, PTAT Current Generation, Constant - Gm Biasing, Speed and Noise Issues.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Behzad Razavi, "*Design of Analog CMOS Integrated Circuits*", McGraw Hill Education, 2<sup>nd</sup> edition, 2017.
2. David A. Johns, Ken Martin "*Analog Integrated Circuit Design*", Wiley , 2<sup>nd</sup> edition 2013.

**REFERENCE BOOKS:**

1. Paul R. Gray, Paul J. Hurst, S. Lewis and R. G. Meyer, "*Analysis and Design of Analog Integrated Circuits*", Wiley India, Fifth Edition, 2013.
2. Philip E. Allen and Douglas R. Holberg, "*CMOS Analog Circuit Design*". Oxford University Press, International third Edition/Indian Edition, 2012.

**IV B. Tech. – I Semester**  
**(19BT70404) CELLULAR AND MOBILE COMMUNICATIONS**  
(Professional Elective - 4)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Analog Communications, Digital Communications & Antennas and Propagation.

**COURSE DESCRIPTION:** Concepts of cellular systems; Lee-model for cellular coverage; Desired C/I; Interference and reduction techniques; Frequency management in cellular systems; Handoff techniques; Various modulation techniques and Multiple Access techniques; 2G Systems – GSM, GPRS; 3G systems – WCDMA, 4G-LTE Systems.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design antenna systems and to analyze cochannel interference in Cellular systems.
- CO2: Analyze Point to point prediction model for different geographical conditions.
- CO3: Apply appropriate handoff techniques for various scenarios to overcome call drops.
- CO4: Demonstrate knowledge on 2G GSM, 3G WCDMA and 4G LTE cellular communication systems and their standards.

**DETAILED SYLLABUS:**

**UNIT-I: (07 Periods)**

**INTRODUCTION TO CELLULAR MOBILE SYSTEMS**

A basic cellular system, performance criteria, uniqueness of mobile radio environment, operation of cellular systems, Hexagonal shaped cells.

**ELEMENTS OF CELLULAR RADIO SYSTEMS DESIGN**

Concept of frequency reuse channels, co-channel interference reduction factor, Design of Antenna systems for worst case, cell splitting

**UNIT-II: (11 Periods)**

**INTERFERENCE REDUCTION AND CELL COVERAGE FOR SIGNAL:** Introduction to co-channel interference, Exploring co-channel interference areas in a system, Design of different antenna systems, Diversity Receiver, Near End Far End Interference, Lee model.

**FREQUENCY MANAGEMENT & CHANNEL ASSIGNMENT:** Frequency Management, fixed channel assignment, non-fixed channel assignment, traffic & channel assignment.

**HANDOFFS:** Introduction to handoff, types of handoff and their characteristics.

**UNIT-III:****(08 Periods)**

**GLOBAL SYSTEM FOR MOBILE (2G SYSTEMS):** GSM architecture, Radio specifications, Communication channels in GSM, Mapping Logical channels on to Physical Channels, signaling during a call.

**GPRS (2.5G SYSTEMS)**

Introduction to GPRS, GPRS support nodes, GPRS Interfaces, GPRS procedures in Packet call setup, GPRS Mobility management.

**UNIT-IV: THIRD GENERATION NETWORK (3G), UMTS****(09 Periods)**

Introduction to 3G, WCDMA concept, Parameters of 3G WCDMA Air interface, Spectrum allocation for WCDMA, 3G services, UMTS Reference network architecture and Interfaces, Air-interface architecture and processing, Channels on the Air Interface, Introduction to High-Speed Packet Data Access (HSPA)

**UNIT-V: 4G-LTE SYSTEMS****(10 Periods)**

Introduction, Architecture of an evolved Packet system, LTE integration with 2G/3G network, E-UTRAN Interfaces, USER Equipment, LTE Mobility, LTE Radio interface, Principles of OFDM, LTE Multiple Access scheme, Single-Carrier FDMA, OFDMA verses SC-FDMA operation, Introduction to MIMO.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. William C. Y. Lee, *Mobile Cellular Telecommunications*, McGraw Hill, 2nd Edition, 1995.
2. Alexander Kukushkin, *Introduction to Mobile Network Engineering: GSM, 3G-WCDMA, LTE and the Road to 5G*, Wiley, First Edition, 2018.

**REFERENCE BOOKS:**

1. Theodore S Rappaport, *Wireless Communication Principles and Practice*, Pearson Education, 2nd Edition, 2002.
2. C. Y. Lee, *Wireless and Cellular Telecommunications*, McGraw Hill, 3<sup>rd</sup> Edition, 2006.

**IV B. Tech. – I Semester**  
**(19BT70405) SPEECH PROCESSING**  
(Professional Elective - 4)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Signals and Systems & Digital Signal Processing

**COURSE DESCRIPTION:** Acoustic Theory of speech production; model for speech signals and speech processing systems; Mathematical analysis of speech signal - Homomorphic and LPC models; Speech and Speaker recognition systems.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze digital models of speech signals for various losses in vocal tract by articulators and estimate pitch period and cepstrum.
- CO2: Understand the operation of different types of synthesizers for speech synthesis.
- CO3: Apply coding using different types of vocoders for speech coding.
- CO4: Use Hidden Markov Model in speech recognition and speaker identification to classify speech for authentication.

**DETAILED SYLLABUS:**

**UNIT-I: DIGITAL MODEL FOR THE SPEECH SIGNAL (10 Periods)**

The process of speech production - the mechanism of speech production, acoustic phonetics. The Acoustic theory of speech production- sound propagation, uniform lossless tubes, Effect of losses in the vocal tract, Effect of radiation at the lips, Vocal tract transfer functions for vowels, the effect of nasal coupling, Excitation of sound in the vocal tract, Digital models for speech signals.

**UNIT-II: TIME DOMAIN MODELS FOR SPEECH PROCESSING (10 Periods)**

Introduction, Window considerations, Short time energy and average magnitude, Short time average zero crossing rate, Speech vs silence discrimination using Average energy and zero crossing, Pitch period estimation using parallel processing approach, The short time autocorrelation function, The short time average magnitude difference function, Cepstral Analysis of Speech.

**UNIT-III: SPEECH SYNTHESIS (07 Periods)**

History of speech synthesis, Formant synthesizers, Linear predictive synthesizers, Copy synthesis, Phoneme synthesis, Concatenation of multi-phonemic units, Text-to-speech synthesis, Articulatory speech synthesis

**UNIT-IV: SPEECH CODING (07 Periods)**

Sub-band coding, Transform coding, Channel Vocoder, Formant vocoder, Cepstralvocoder, Linear predictive vocoders, The LPC-10 algorithm, Multi-pulse and RELP vocoders, Vector quantiser coders.

**UNIT-V: SPEECH AND SPEAKER RECOGNITION SYSTEMS****(11 Periods)**

Basic pattern recognition approaches, parametric representations of Speech recognition, Speech recognition system- isolated digit recognition system. Speaker Verification vs. recognition, features that distinguish speaker, Speaker recognition system-speaker verification system, speaker identification systems, Hidden Markov models, Word recognition using HMMs, Training hidden Markov models.

**Total Periods: 45*****Topics for Self-Study are provided in the Lesson Plan*****TEXT BOOKS:**

1. L.R. Rabiner and R.W. Schafer, *Digital processing of speech signals*, Pearson Education, 2006.
2. F. J. Owens, *Signal Processing of Speech*, Macmillan, 1993.

**REFERENCE BOOKS:**

1. Douglas O Shaughnessy, *Speech Communications*, Oxford University Press, 2<sup>nd</sup> Edition, 2000
2. L R Rabiner, BH Juang, B Yegnanarayana, *Fundamentals of Speech Recognition*, Pearson Education, 2009.



**IV B. Tech. - I Semester**  
**(19BT70406) ADAPTIVE SIGNAL PROCESSING**  
(Professional Elective - 5)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Digital Signal Processing.

**COURSE DESCRIPTION:** Development of adaptive filter theory; Method of steepest descent; Least-Mean-Square Algorithm and recursive least square algorithm; Kalman filtering algorithm; order-recursive adaptive filters.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze Error- Performance Surface of linear optimum and adaptive filters.
- CO2: Analyze Steepest-Descent Algorithm to assess the error performance of the Wiener filters.
- CO3: Apply LMS and RLS Algorithms for error minimization in noise cancellation.
- CO4: Apply kalman and non Linear adaptive filters in the fields of signal processing, communications, Bio-Medical, Instrumentation and control engineering for error optimization.
- CO5: Analyze order recursive adaptive filters to estimate mean square error.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO ADAPTIVE SYSTEMS & DEVELOPMENT OF ADAPTIVE FILTER THEORY (10 Periods)**

Eigen Value Problem, Properties of eigen values and eigen vectors (proof is not required), Eigen Filters, eigen Value computations. The Filtering problem, Linear Optimum Filters, Adaptive Filters, Linear Filter structures, Approaches to the development of linear adaptive filters. Linear Optimum Filtering: Statement of the problem, Principle of Orthogonality, Minimum Mean Square Error, Wiener- Hopf equations, Error- Performance Surface.

**UNIT-II: METHOD OF STEEPEST DESCENT (07 Periods)**

Basic Idea of Steepest-Descent Algorithm, Steepest-Descent Algorithm applied to the Wiener Filter, Stability of the Steepest-Descent Algorithm, Examination of the transient behavior of the Steepest-Descent Algorithm, the Steepest-Descent Algorithm as a deterministic search method, Virtue and limitation of the Steepest-Descent Algorithm.

**UNIT-III: LEAST-MEAN-SQUARE ADAPTIVE FILTERS AND RECURSIVE LEAST-SQUARES ADAPTIVE FILTERS (10 Periods)**

Overview of the structure and operation of the Least-Mean-Square Algorithm, Least-Mean-Square adaptation Algorithm, Applications-Adaptive Noise cancelling Applied to a Sinusoidal Interference and Adaptive Beam forming, Comparison of the LMS Algorithm with Steepest-Descent Algorithm.

Matrix Inversion lemma, exponentially weighted recursive least square algorithm, update recursion for the sum of weighted error squares, Single-Weight Adaptive Noise Canceller convergence analysis of RLS Algorithm.

#### **UNIT-IV: KALMAN FILTERING & NON LINEAR ADAPTIVE FILTERING**

**(10 Periods)**

Recursive Minimum Mean-Square Estimation for Scalar Random variables, Statement of Kalman filtering problem, The Innovations Process, estimation of the state using the Innovations Process, Filtering, Initial conditions, Extended kalman filter.

An overview of the Blind Deconvolution problem, Buss Gang Algorithm for blind Equalization.

#### **UNIT-V: ORDER-RECURSIVE ADAPTIVE FILTERS**

**(08 Periods)**

Gradient-Adaptive Lattice Filter, order-recursive adaptive filters using least square estimation, adaptive forward linear prediction, adaptive backward linear prediction, conversion factor, least-square lattice predictor, angle-normalized estimation errors, first order state space models for lattice filtering.

**Total periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOK:**

1. Simon Haykin, *"Adaptive Filter Theory"*, Pearson Education, 5<sup>th</sup> edition, 2014.

#### **REFERENCE BOOK:**

1. Bernard Widrow, Samuel D. Stearns, *"Adaptive Signal Processing"*, Pearson Education, 1<sup>st</sup> edition, 2002.

**IV B. Tech. - I Semester**  
**(19BT70407) ERROR CONTROL CODING**  
(Professional Elective - 5)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Analog Communications and Digital Communications

**COURSE DESCRIPTION:**

Mathematical concepts related to coding; Channel coding techniques – Linear Block Codes, Cyclic Codes, Binary BCH Codes and Convolutional Codes

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand mathematical concepts related to coding.
- CO2: Analyze the concepts involved in formulation and computation of Linear Block Codes.
- CO3: Analyze the concepts involved in formulation and computation of Cyclic Codes and Binary BCH Codes.
- CO4: Analyze Convolutional Codes and different algorithms associated with Convolutional Coding.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION (10 Periods)**

**Coding for Reliable Digital Transmission and Storage** – Types of codes, Modulation and coding, Maximum likelihood decoding, Types of errors, Error control strategies, Coded modulation. Introduction to Algebra- Groups & fields, Binary field arithmetic, Construction of Galois field and its basic properties, Computations, Vector spaces, matrices.

**UNIT-II: LINEAR BLOCK CODES (10 Periods)**

**Linear Block Codes:** Introduction linear block codes, Syndrome and Error detection, Error detection and Error correction capabilities of a Block code, Standard array and syndrome decoding, Probability of an undetected error for linear codes over a BSC, Single parity check codes, repetition codes, and self-dual codes, A class of single error correcting and double error detecting codes, Reed-Muller codes and other constructions, The squaring construction of codes, The Golay code, Interleaved codes, Illustrative Problems.

**UNIT-III: CYCLIC CODES (08 Periods)**

**Cyclic Codes:** Description of Cyclic codes, Generator and parity – check matrices of cyclic codes, Encoding of Cyclic codes, Syndrome computation and error detection, Decoding of cyclic codes, Cyclic Hamming codes, The (23,12) Golay code, Shortened cyclic codes, Cyclic product codes.

**UNIT-IV: BINARY BCH CODES****(08 Periods)**

Binary primitive BCH codes, Decoding of BCH codes, Iterative algorithm for finding the error location polynomial & its iterative algorithm, Finding the error location numbers and error correction, Correction of errors and erasures, Implementation of Galois Field arithmetic, Implementation of error correction, Weighted distribution & Error detection of binary BCH codes, Illustrative Problems.

**UNIT-V: CONVOLUTIONAL CODES:****(09 Periods)**

Convolutional Codes: Encoding of Convolutional codes, Structural properties and distance properties of Convolutional codes, The Viterbi Algorithm, Performance bounds for Convolutional codes, Construction of good Convolutional codes, Implementation and performance of the Viterbi algorithm, The soft output of Viterbi algorithm (SOVA), The BCJR algorithm, Punctured and Tail-biting Convolutional codes, Illustrative problems.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Shu Lin, Daniel J. Costello, Jr., "*Error Control Coding*," Pearson Publications, Second Edition, 2011.
2. Bernard Sklar, Pabitra Kumar Ray, "*Digital Communications Fundamentals and Applications*," Pearson Publications, Second Edition, 2009.

**REFERENCE BOOKS:**

1. Thomas M. Cover and Joy A. Thomas, "*Elements of Information Theory*", John Wiley & Sons, 1<sup>st</sup> Edition, 1999.
2. John G. Proakis, "Digital Communications", Mc.GrawHill Publication, 5<sup>th</sup> Edition, 2008.

**ADDITIONAL LEARNING RESOURCES:**

NPTEL Courses

**IV B. Tech. - I Semester**  
**(19BT70408) LOW POWER CMOS VLSI DESIGN**  
(Professional Elective - 5)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** A Course on VLSI Design.

**COURSE DESCRIPTION:** Basic Principles; Methodologies and techniques of CMOS Circuit Designs; Need For Low Power VLSI Design; Principles Of Low Power Circuit Design; Simulation Analysis of Low Power; Logic and Circuit Analysis; Special Techniques and Advanced Techniques Of Low Power Design; Performance Management in Architecture or System level.

**COURSE OUTCOMES:** After successful completion of this course, students will be able to

- CO1: Demonstrate low power design requirements for CMOS VLSI circuits.
- CO2: Analyze and estimate power at Logic and Circuit abstraction levels of digital systems.
- CO3: Develop alternate circuits and logic for analysis of low power circuits.
- CO4: Apply special and advanced low power techniques at circuit, architecture and system levels to develop CMOS devices.

**DETAILED SYLLABUS:**

**UNIT-I: BASICS OF LOW POWER DESIGN (07 Periods)**

Needs For Low Power VLSI Chips, Charging And Discharging Capacitances, Short Circuit Current in CMOS, CMOS Leakage Current, Static Current, Basic Principles Of Low Power Design, Low Power Figure Of Merits, Low Power VLSI Design Limits.

**UNIT-II: POWER ANALYSIS AND ESTIMATION (10 Periods)**

Spice Circuit Simulation, Discrete Transistor Modeling and Analysis, Gate Level Logic Simulation, Architecture Level Analysis, Data Correlation Analysis, Monte Carlo Simulation.

**UNIT-III: LOW POWER CIRCUITS (11 Periods)**

**Circuit Analysis:**

Transistor and Gate Sizing, Equivalent Pin Ordering, Network Restructuring and Reorganization, Special latches and Flip flops.

**Logic Analysis:**

Gate Reorganization, Signal Gating, Logic Encoding, State Machine Encoding, Pre computation Logic.

**UNIT-IV: SPECIAL TECHNIQUES****(08 Periods)**

Power Reduction in Clock Networks, CMOS Floating Node, Low Power Bus, Delay Balancing, Low Power Techniques for SRAM.

**UNIT-V: ARCHITECTURE, SYSTEM&ADVANCED TECHNIQUES****(09 Periods)**

Power and Performance Management, Switching Activity Reduction, Adiabatic Computation, Pass Transistor Logic Synthesis, Asynchronous Circuit.

**Total Periods: 45****Topics for Self-Study are provided in the Lesson Plan****TEXT BOOK:**

1. Gary Yeap, *Practical Low-Power Digital VLSI Design*, Springer Publication, 2012.

**REFERENCE BOOKS:**

1. A.P.Chandrakasan, R.W.Brodersen, *Low Power Digital CMOS Design*, Kluwer, Springer US, 2012.
2. Kaushik Roy, Sharat Prasad, *Low-Power CMOS VLSI Circuit Design*, Wiley Student Edition, 2009.

**ADDITIONAL LEARNING RESOURCES:**

<https://nptel.ac.in/courses/106/105/106105034/>

<https://nptel.ac.in/courses/117/101/117101004/>

**IV B. Tech. - I Semester**  
**(19BT70409) REAL TIME SYSTEMS**  
(Professional Elective - 5)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Switching Theory and Logic Design & Microcontrollers.

**COURSE DESCRIPTION:** Real Time Systems Modeling; Scheduling Approaches; Multiprocessor and Distributed Scheduling Algorithms; Fault Tolerant Systems; Real Time Operating Systems.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze Real Time System Characterization, Workload and Resource management algorithms and apply suitable techniques to model hard and soft real time systems.
- CO2: Solve scheduling problems and apply suitable techniques in constrained RT systems by surveying various Real Time scheduling approaches for uniprocessor, Multiprocessor and distributed environments.
- CO3: Evaluate appropriate Fault tolerant techniques and apply them to design fail safe RT systems.
- CO4: Implement Efficient Real Time Systems porting suitable operating system on to hardware by Investigating POSIX standard Kernel structure, services and Kernel objects.

**DETAILED SYLLABUS:**

**UNIT-I: MODELING OF REAL TIME SYSTEMS (09 Periods)**

Hard Vs Soft Real Time Systems, A Reference Model of Real Time Systems- Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency. Functional Parameters, Resource Parameters of Jobs and Parameters of Resources, Scheduling hierarchy.

**UNIT-II: APPROACHES TO REAL TIME SCHEDULING (09 Periods)**

Clock Driven, Weighted Round Robin, Priority Driven, Dynamic Vs Static Systems, Effective Release Times and Dead Lines, Optimality and Non-optimality of EDF and LST algorithms, Challenges in Validating Timing Constraints in Priority Driven Systems, Offline Vs Online Scheduling.

**UNIT-III: SCHEDULING REAL TIME TASKS IN MULTIPROCESSOR AND DISTRIBUTED SYSTEMS (09 Periods)**

Multiprocessor task allocation, Dynamic allocation of tasks, Fault tolerant scheduling of tasks, Clocks in distributed Real Time Systems, Centralized clock distribution, Distributed clock synchronization.

**UNIT-IV: FAULT TOLERANCE TECHNIQUES****(09 Periods)**

Introduction, Failures- Causes, Types, Detection. Fault and Error Containment, Redundancy- Hardware, Software, Time, Integrated Failure Handling.

**UNIT-V: OPERATING SYSTEMS****(09 Periods)**

Overview- Threads and Tasks, the Kernel. Time Services and Scheduling Mechanisms, Basic Operating System Functions- Communication and Synchronization, Event Notification and Software Interrupt Memory Management, I/O and Networking. Processor Reserves and Resource Kernel, Capabilities of Commercial Real Time Operating Systems.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Jane W.S. Liu, "*Real Time Systems*", Pearson Education, 1st Edition, 2006.
2. Rajib Mall, "*Real Time Systems-Theory and Practice*", Pearson Education India, 1<sup>st</sup> Edition, Nov.2012.
3. C. M. Krishna, Kang G Shin, "*Real Time Systems*", MCgraw-Hill Series,1997

**REFERENCE BOOKS:**

1. Phillip A. Laplante and Seppo J. Ovaska, "*Real-Time Systems Design and Analysis: Tools for the Practitioner*", Wiley-IEEE Press, 4th edition, Nov. 2011.
2. Hermann Kopetz, "*Real-Time Systems: Design Principles for Distributed Embedded Applications* ", Springer; 2nd Edition, 2011.



**IV B. Tech. - I Semester**  
**(19BT70431) ANTENNAS AND MICROWAVE ENGINEERING LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** Courses on Antennas and propagation & Microwave Engineering.

**COURSE DESCRIPTION:** Design and Simulation of various antennas, study of characteristics microwave sources and components.

**COURSE OUTCOMES:** After successful completion of this course, students will be able to:

- CO1: Design monopole, half wave dipole, yagi-uda, horn, patch etc., antennas for establishing wireless communication.
- CO2: Analyze return loss, VSWR, Gain, Directivity, Radiation Pattern etc., of the Simulated antenna.
- CO3: Analyze the characteristics of microwave sources and estimate the performance of microwave components.
- CO4: Work independently and in teams to solve problems with effective Communication.

**List of Exercises/List of Experiments:**

**PART-A: (Antennas)**

(Minimum **six experiments** are to be conducted)

1. Design Monopole Antenna to operate at 1GHz and verify its associated parameters using HFSS Tool.
2. Design Half Wave Dipole Antenna to operate at 1GHz and verify its associated parameters using HFSS Tool.
3. Design Folded Dipole Antenna to operate at 500MHz and verify its associated parameters using HFSS Tool.
4. Design Yagi-Uda Array Antenna with minimum of five elements to operate at 500MHz and verify its associated parameters using HFSS Tool.
5. Design Helical Antenna to operate at 10GHz and verify its associated parameters using HFSS Tool.
6. Design Horn Antenna to operate at 10GHz and verify its associated parameters using HFSS Tool.
7. Design Microstrip Patch Antenna with strip feeding to operate at 2.4 GHz and verify its associated parameters using HFSS Tool.
8. Design Microstrip Patch Antenna with probe feeding to operate at 2.4 GHz and verify its associated parameters using HFSS Tool.

### **PART-B: (Microwave Engineering)**

9. Using Microwave Bench setup, verify the mode and voltage characteristics of Reflex Klystron Oscillator.
10. Using Microwave Bench setup, verify the V-I characteristics of Gunn Diode Oscillator and find its dynamic resistance.
11. Using Microwave Bench setup, find the Attenuation Factor for the given rectangular waveguides.
12. Using Microwave Bench setup, find the Coupling Factor and Directivity for the given Directional Couplers.
13. Using Microwave Bench setup, find the VSWR for the given Antennas.
14. Using Microwave Bench setup, find cutoff wavelength, free space wavelength and guide wavelength for the given Waveguide.

### **Experiments Beyond Syllabus:**

1. Using Microwave Bench Setup, measure the radiation pattern of the given horn antenna.
2. Using Microwave Bench Setup, prove reciprocity theorem as applicable to antennas.

### **REFERENCE BOOKS/LABORATORY MANUALS:**

1. John D. Kraus and Ronald J. Marhefka and Ahmad S.Khan, *Antennas and Wave Propagation*, TMH, 4<sup>th</sup> Edition, 2010.
2. Samuel Y. Liao, *Microwave devices and circuits*, Pearson Education, 3<sup>rd</sup> Edition, 2003.
3. SVEC - ECE Department, *Antennas and Microwave Engineering Lab Manual*.

### **SOFTWARE/Tools used:**

High Frequency Structure Simulator (HFSS Version 2016.2)/ Symica TCAD Tool

**IV B. Tech. - I Semester**  
**(19BT70432) EMBEDDED SYSTEMS LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** Courses on Switching Theory and Logic Design, Linear and Digital IC Applications & Microcontrollers.

**COURSE DESCRIPTION:** Familiarization using IDE – CCS, Energia; Instruction Set usage; GPIO – programming; Watchdog timer; Timer, ADC, Comparator – Programming; Low Power Modes demonstration; PWM generation – Speed Control of DC Motor; Networking MSPs.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze MSP430 Architecture, Instruction Set and Demonstrate Competence in developing programs using Assembly and Embedded C.
- CO2: Solve various Problems using CCS and Energia IDE effectively by evaluating various on-chip resources.
- CO3: Develop programs to realize control applications such as Speed control of DC Motor, Reading Ambient Temperature by investigating various interfacing techniques.
- CO4: Survey usage of MSP430 for Mixed Signal Processing and IOT Applications to establish communication deploying various protocols.
- CO5: Work independently and in teams to solve problems with effective Communication.

**List of Exercises/List of Experiments: (Minimum Ten Experiments to be done)**

1. Introduction to MSP430 launch pad and Programming Environment.
2. Practice on usage of Instruction Set
3. Read input from switch and Automatic control/flash LED (software delay).
4. Interrupts programming example using GPIO.
5. Configure watchdog timer in watchdog & interval mode.
6. Configure timer block for signal generation (with given frequency).
7. Read Temperature of MSP430 with the help of ADC.
8. Test various Power Down modes in MSP430.
9. Generation of Pulse Width Modulation.
10. Use Comparator to compare the signal threshold level.
11. Speed Control of DC Motor
12. Master slave communication between MSPs using SPI.
13. Networking MSPs using Wi-Fi.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. John H Davies, *MSP430 Microcontrollers Basics*, Newnes Publishers, 1<sup>st</sup> Edition, 2008.
2. C P Ravikumar, *MSP430 Microcontrollers in Embedded System Projects*, Elite Publishing House, 1<sup>st</sup> Edition, 2012.

**SOFTWARE/Tools used:**

Code Composer Studio Version 6, Energia, MSP430 launch pads, Wi-Fi booster pack.

**IV B.Tech. - I semester**  
**(19BT70433) INTERNSHIP**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| -          | 100        | 100         | - | - | - | 2 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:** Expose students to the industrial environment; Create competent professionals for the industry; sharpen the real time technical / managerial skills required at the job; Gain professional experience and understand engineer's responsibilities and ethics; Familiarize with latest equipment, materials and technologies; Gain exposure to technical report writing; Gain exposure to corporate working culture.

**COURSE OUTCOMES:** After successful completion of the course, the students will be able to:

- CO1:** Analyze latest equipment, materials and technologies that are used in industry to solve complex engineering problems following relevant standards, codes, policies and regulations.
- CO2:** Analyze safety, health, societal, environmental, sustainability, economical and managerial factors considered in industry in solving complex engineering problems.
- CO3:** Perform individually or in a team besides communicating effectively in written, oral and graphical forms on practicing engineering.

**IV B. Tech. - I Semester**  
**(19BT704AC) PRINCIPLES OF OPERATING SYSTEMS**  
(Audit course)

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| -          | -          | -           | 2 | - | - | - |

**PRE-REQUISITE: -**

**COURSE DESCRIPTION:** Basics of Operating System; Process Management; Scheduling; Process Synchronization; Deadlocks; Memory Management; I/O Management; Disk Scheduling; File Systems.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on basics and types of Operating Systems, Process management and scheduling.
- CO2: Analyze scheduling algorithms, process synchronization, Memory and I/O Management, File Organization and access methods

**DETAILED SYLLABUS:**

**UNIT-I: (06 Periods)**

**INTRODUCTION TO OPERATING SYSTEM:** Definition, need, objectives of Operating System; Evolution, Real-time Operating System; System Components; Services; System Calls; Types of Operating Systems; Virtual Machines; System Design and Implementation.

**UNIT-II: (06 Periods)**

**PROCESS MANAGEMENT:** Process, Process States; Multiple and Cooperating Processes; Process Control Block and Context Switching, Process Control, Inter Process Communication; Exception Conditions, Threads, Symmetric Multi-processing.

**SCHEDULING:** Basics, Scheduler; Types of Scheduling; Scheduling Criteria, CPU Scheduling Algorithms.

**UNIT-III: (06 Periods)**

**PROCESS SYNCHRONIZATION:** Introduction, Racing Problem, Critical Section, Mutual Exclusion; Semaphores, Producer Consumer Problem; Readers and writers Problem; Monitors, Message Passing.

**DEADLOCKS:** Introduction, conditions for deadlock; deadlock detection, prevention, avoidance, and recovery.

**UNIT-IV: (07 Periods)**

**MEMORY MANAGEMENT:** Introduction, Logical Vs Physical Addressing; Memory Management Requirement; Loading Program into main memory; Memory allocation; Page Replacement Algorithms.

**I/O MANAGEMENT AND DISK SCHEDULING:** I/O- devices, functions, and buffering; Spooling, Operating System design issues; Disk I/O, Disk Scheduling Algorithms.

**UNIT-V: (05 Periods)**

**FILE SYSTEMS:** Introduction, File attributes and Naming; File Organization and access methods; Directory Structures; File Protection and File System Organization.

**Total Periods: 30**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. V. Ramesh, *Principles of Operating Systems*, University Science Press, 2010.
2. Abraham Silberschatz, Greg Gagne, Peter B. Galvin, *Operating System Concepts*, 7<sup>th</sup> Edition, Wiley India, 2011.

**REFERENCE BOOK:**

1. William Stallings, *Operating Systems, Internals and Design Principles*, 7<sup>th</sup> Edition, Pearson Education, 2013.

**IV B. Tech. - II semester**  
**(19BT80431) PROJECT WORK**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C  |
|------------|------------|-------------|---|---|---|----|
| 100        | 100        | 200         | - | - | - | 10 |

**PREREQUISITES: -**

**COURSE DESCRIPTION:**

Identification of topic for the project work; Literature survey; Collection of preliminary data; Identification of implementation tools and methodologies; Performing critical study and analysis of the topic identified; Time and cost analysis; Implementation of the project work; Preparation of thesis and presentation.

**COURSE OUTCOMES:** After successful completion of the course, the students will be able to:

- CO1: Create/Design Electronics and Communication Engineering systems or processes to solve complex Electronics and Communication Engineering and allied problems using appropriate tools and techniques following relevant standards, codes, policies, regulations and latest developments.
- CO2: Consider society, health, safety, environment, sustainability, economics and project management in solving complex Electronics and Communication Engineering and allied problems.
- CO3: Perform individually or in a team besides communicating effectively in written, oral and graphical forms on Electronics and Communication Engineering systems or processes.



# **HONORS DEGREE**

**in**

**ELECTRONICS AND COMMUNICATION  
ENGINEERING**

**(SVEC-19 Regulations)**

## **Honors Degree in Electronics and Communication Engineering**

| Semester                         | Course code | Course title                           | Contact Periods per week |   |   | C | Scheme of Examination Max. Marks |            |             |
|----------------------------------|-------------|----------------------------------------|--------------------------|---|---|---|----------------------------------|------------|-------------|
|                                  |             |                                        | L                        | T | P |   | Int. Marks                       | Ext. Marks | Total Marks |
| III B.Tech<br>I-Sem. (2 Theory)  | 19BT50410   | ASIC Design                            | 3                        | - | - | 3 | 40                               | 60         | 100         |
|                                  | 19BT50411   | Data communications and networks       | 3                        | - | - | 3 | 40                               | 60         | 100         |
|                                  | 19BT50412   | Detection and Estimation of Signals    | 3                        | - | - | 3 | 40                               | 60         | 100         |
|                                  | 19BT50413   | Physical Design Automation             | 3                        | - | - | 3 | 40                               | 60         | 100         |
| III B.Tech<br>II-Sem. (2 Theory) | 19BT60411   | Advanced Digital Communication Systems | 3                        | - | - | 3 | 40                               | 60         | 100         |
|                                  | 19BT60412   | Audio signal processing                | 3                        | - | - | 3 | 40                               | 60         | 100         |
|                                  | 19BT60413   | Network-on-Chip Design                 | 3                        | - | - | 3 | 40                               | 60         | 100         |
|                                  | 19BT60414   | RF IC Design                           | 3                        | - | - | 3 | 40                               | 60         | 100         |
| IV B.Tech<br>I-Sem. (2 Theory)   | 19BT70410   | Advanced Wireless Communications       | 3                        | - | - | 3 | 40                               | 60         | 100         |
|                                  | 19BT70411   | Optical networks                       | 3                        | - | - | 3 | 40                               | 60         | 100         |
|                                  | 19BT70412   | Pattern Recognition                    | 3                        | - | - | 3 | 40                               | 60         | 100         |
|                                  | 19BT70413   | VLSI Signal Processing                 | 3                        | - | - | 3 | 40                               | 60         | 100         |

**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Honors degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

**III B. Tech. – I Semester**  
**(19BT50410) ASIC DESIGN**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Switching Theory and Logic Design.

**COURSE DESCRIPTION:** ASIC design categories; Design Libraries; Design Entry; Logic Synthesis; Simulation; Testing; Physical design flow of ASIC.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze full custom and semi custom ASIC's and its design types to improve the performance characteristics of digital systems in multidisciplinary environments like microprocessors, Digital Signal processing, wireless communication, biomedical engineering, speech processing, video processing, etc
- CO2: Realize and estimate the parasitic calculations and logical effort in the analysis of programmable ASICs.
- CO3: Analyze the low level schematic entry and logic synthesis of Finite state machines to estimate the performance of ASIC design.
- CO4: Analyze various simulation types and its testing to estimate the static timing parameters of an ASIC.
- CO5: Apply floor planning, Placement and routing methods to attain optimal solution for the development of ASICs.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO ASICS (09 Periods)**

Types of ASICs- Full-Custom ASICs, Semicustom ASICs, Standard cell based ASICs, Gate- array based ASICs, Channeled Gate Array, Channel less Gate Array, Structured Gate Array, Field-Programmable Gate Arrays, ASIC Design Flow, ASIC Cell Libraries.

**UNIT-II: ASIC LIBRARY DESIGN & PROGRAMMABLE ASICS (09 Periods)**

**ASIC LIBRARY DESIGN:** Transistors as Resistors, Transistor Parasitic Capacitance, Logical Effort, Library cell design, Library Architecture, Gate-Array Design, Standard-Cell Design.

**PROGRAMMABLE ASICs:** Anti fuse, Static RAM, EPROM and EEPROM technology, Practical Issues, Specifications.

**UNIT-III: LOW-LEVEL DESIGN ENTRY & LOGIC SYNTHESIS (09 Periods)**

**LOW-LEVEL DESIGN ENTRY:** Schematic Entry, Hierarchical design, The cell library, Names, Schematic Icons & Symbols, Nets, Schematic Entry for ASICs, Connections, Vectored instances and Buses, Net list Screener, Back-Annotation.

**LOGIC SYNTHESIS:** A Logic-Synthesis Example, Verilog and Logic Synthesis, VHDL and Logic Synthesis, Finite-State Machine Synthesis.

**UNIT-IV: SIMULATION, TESTING & ASIC CONSTRUCTION (10 Periods)**

**SIMULATION AND TESTING:** Types of Simulation -Structural Simulation, Gate-Level Simulation, Static Timing Analysis, Formal Verification, Switch-Level Simulation, Transistor-Level Simulation, Faults, Fault simulation, Automatic Test-Pattern Generation.

**ASIC CONSTRUCTION:** Physical Design, System Partitioning, FPGA Partitioning, Partitioning Methods.

**UNIT-V: FLOOR PLANNING, PLACEMENT & ROUTING (08 Periods)**

**FLOOR PLANNING AND PLACEMENT:** Floor planning, Placement, Physical Design Flow, **ROUTING:** Global Routing, Detailed Routing, Special Routing, Circuit Extraction and DRC.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. M.J.S.Smith, "*Application - Specific Integrated Circuits*", Addison-Wesley Longman Inc 2008.
2. L.J.Herbst, "*Integrated circuit engineering*", OXFORD SCIENCE Publications, 1996.

**REFERENCE BOOKS:**

1. Neil H.E. Weste & Kamran Eshraghian, "*Principles of CMOS VLSI Design : A System Perspective*", Addison – Wesley Publication, 2002.
2. John P.Uyemura, "*Introduction to VLSI Circuits and Systems*", Wiley Edition, 2002.

**III B. Tech. - I Semester**  
**(19BT50411) DATA COMMUNICATIONS AND NETWORKS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Analog Communications and Digital Communications.

**COURSE DESCRIPTION:** Data types, Layered architecture, types, Network types, Quality measures, various Data link and MAC protocols, Network routing and congestion control protocols, Transport protocols and Example networks.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on various layered architectures, Application protocols and standards.
- CO2: Design appropriate Data link and network protocols for Reliable Data transfer services.
- CO3: Apply various network layer protocols for Data Communication and networking.
- CO4: Analyze transport protocols for Congestion control, Connection establishment and release .

**DETAILED SYLLABUS:**

**UNIT I: NETWORK MODELS & PHYSICAL MEDIA (10 Periods)**

Introduction: Data Communications, Networks, The Internet, Protocols and Standards; Network Models: Layered Tasks, The OSI Model, Layers in the OSI Model, TCP/IP model, Addressing; Physical Layer and Media: Data Rate Limits, Performance; Bandwidth utilization: Multiplexing and Spreading, Multiplexing, Spread Spectrum; Transmission Media: Guided Media, Unguided Media; Switching: Circuit-Switched Networks, Datagram Networks, Virtual-Circuit Networks;

**UNIT-II: DATALINK LAYER (11 Periods)**

Error Detection and Correction: Introduction, Block Coding, Cyclic Codes: Cyclic Redundancy Check, Polynomials, Checksum; Data Link Control: Framing, Flow and Error Control, Protocols, Noiseless Channels, Noisy Channels, HDLC, Multiple Access: Random Access, Aloha, Controlled Access, Wired LANs: Standard Ethernet, Changes in the Standard, Fast Ethernet, Gigabit Ethernet; Wireless LANs: IEEE 802.11, Connecting Devices, Wireless WANs: Cellular Telephony, Satellite Networks, Virtual-Circuit Networks: Frame Relay, ATM.

**UNIT-III: NETWORK LAYER (08 Periods)**

Network Layer: Logical Addressing, IPv4 Addresses, IPv6 Addresses, Network Layer-Internet Protocol: Internetworking, IPv4, IPv6, Transition from IPv4 to IPv6, Network Layer: Address Mapping, Error Reporting and Multicasting, Address Mapping, ICMP, Network Layer- Delivery, Forwarding and Routing: Delivery, Forwarding, Unicast Routing Protocols, Multicast Routing Protocols.

**UNIT IV: TRANSPORT LAYER****(09 Periods)**

Transport Layer: Process-to-Process Delivery, User Datagram Protocol (UDP), TCP, Congestion Control and Quality of Service, Data Traffic, Congestion, Congestion Control in TCP, Quality Service, Techniques to improve QoS, Integrated Services, Differentiated Services.

**UNIT-V: APPLICATION LAYER****(09 Periods)**

DNS, WWW and HTTP, Network Management, Multimedia: Digitizing Audio and Video, Audio and Video Compression, Streaming Stored Audio/Video, Streaming Live Audio/Video, Real-Time Interactive Audio/Video, RTP, RTCP, Voice over IP.

**Total Periods: 47**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOK:**

1. Behrouza A. Forouzan, "*Data Communications and Networking*", TMH, Fourth Edition, 2007.

**REFERENCE BOOKS:**

1. Andrew S. Tanenbaum, "*Computer Networks*", Pearson education, 4th edition, 2003.
2. Behrouza A. Forouzan, Firouz Mosharraf, "*Computer Networks – A Top-Down Approach*", TMH, SIE, 2012.

**III B. Tech - I Semester**  
**(19BT50412) DETECTION AND ESTIMATION OF SIGNALS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Probability and Stochastic Processes.

**COURSE DESCRIPTION:** Decision criteria for single and multiple observations; Estimation techniques; Properties of estimators; parameter Estimation.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to

- CO1: Apply different decision criteria for detection of signals with Single & multiple observations in additive Gaussian Noise and model Integrating Optimum & Matched Filter Receivers.
- CO2: Apply different Estimation criteria and analyze properties of estimators to optimize error performance.
- CO3: Estimate state and statistical parameters to evaluate the performance of the systems.

**DETAILED SYLLABUS:**

**UNIT-I: DETECTION THEORY (09 Periods)**

Binary Decisions: Single observation–Maximum-likelihood decision criterion, Neyman-Pearson criterion, Receiver operating characteristics, Probability-of-error criterion, Bayes risk criterion, Min-max criterion. Problem solving.

**UNIT-II: BINARY DECISIONS: MULTIPLE OBSERVATIONS (09 Periods)**

Vector observations, the general Gaussian Problem, Waveform Observation in Additive Gaussian Noise, The Integrating Optimum Receiver, Matched Filter Receiver, Problem solving.

**UNIT-III: ESTIMATION THEORY (10 Periods)**

Maximum-likelihood estimation, Bayes estimation criterion - Mean Square Error Criterion, Uniform Cost Function, Absolute-Value Cost Function. Linear minimum-Variance and Least Squares Method, Estimation in the presence of Gaussian noise - Linear observation, Non-linear estimation. Problem solving.

**UNIT-IV: PROPERTIES OF ESTIMATORS (08 Periods)**

Bias, Efficiency, Cramer-Rao bound, Asymptotic properties, Sensitivity and error analysis.

**UNIT-V: STATE ESTIMATION & STATISTICAL ESTIMATION OF PARAMETERS**

**(09 Periods)**

**State Estimation:** Prediction, Kalman filter, Problem solving.

**Statistical Estimation of Parameters:** Concept of sufficient statistics, Exponential families of Distributions, Exponential families and Maximum likelihood estimation, uniformly minimum-variance unbiased estimation.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. James L.Melsa & David L.Cohn, "*Decision and Estimation Theory*", McGraw Hill, 1978.
2. Steven M. Kay, "*Fundamentals of Statistical Signal Processing Vol.1: Estimation Theory*", Prentice-hall, 1<sup>st</sup> edition 1993, Vol.2: *Detection Theory*", Prentice-hall Inc, 1<sup>st</sup> edition 1998.

**REFERENCE BOOKS:**

1. Harry L. Van Trees, "*Detection, Estimation and Modulation Theory*", Part 1, John Wiley & Sons Inc. 2<sup>nd</sup> edition, 2013.
2. Sophocles J.Orfanidis, "*Optimum Signal Processing*", McGraw Hill, 2<sup>nd</sup> edition, 2007.



**III B. Tech. – I Semester**  
**(19BT50413) PHYSICAL DESIGN AUTOMATION**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Switching Theory and Logic Design.

**COURSE DESCRIPTION:** Basics of VLSI design; Layout optimization; Simulation and synthesis; Physical design of FPGAs and MCMs.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply algorithmic graph theory to optimize area and reduce complexity in Physical Design Automation.
- CO2: Analyze design rules, placement, partition and floorplan algorithms to solve compaction and routing problems in the development of layouts.
- CO3: Analyze the gate and switch level simulation and perform two level logic synthesis.
- CO4: Apply assignment and scheduling algorithms to model hardware and obtain high level synthesis.
- CO5: Analyze various FPGA and MCM technologies to implement physical design cycle for the development of alternative and reconfigurable designs.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO VLSI DESIGN METHODOLOGIES (09 Periods)**

Introduction to VLSI Design automation tools, Introduction to algorithmic graph theory, Computational Complexity, Tractable and Intractable problems, Combinational optimization.

**UNIT-II: LAYOUT COMPACTION (09 Periods)**

Design rules, Problem formulation, Algorithms for constraint graph compaction, Placement & Partitioning algorithms. Floor planning concepts- Shape functions and floor plan sizing, Types of routing problems.

**UNIT-III: SIMULATION AND SYNTHESIS (08 Periods)**

Gate Level Modeling and Simulation, Switch Level Modeling and Simulation.

Basic issues and Terminology, Binary-Decision diagrams, Two-Level logic Synthesis.

**UNIT-IV: HIGH LEVEL SYNTHESIS (10 Periods)**

Hardware modeling, internal representation of the input algorithm, allocation, assignment and scheduling algorithms, ASAP scheduling, Mobility based scheduling, list scheduling & force-directed scheduling.

## **UNIT-V: PHYSICAL DESIGN AUTOMATION OF FPGAs & MCMs (09 Periods)**

FPGA technologies, Physical Design cycle for FPGAs, partitioning and Routing for segmented and staggered Models, MCM technologies, MCM physical design cycle.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

### **TEXTBOOKS:**

1. S.H.Gerez, "*Algorithms for VLSI Design Automation*", John Wiley & Sons Pvt. Ltd, 2<sup>nd</sup> Edition 2008.
2. Naveed Sherwani, "*Algorithms for VLSI Physical Design Automation*", Springer International Edition, 3<sup>rd</sup> edition, 2005.

### **REFERENCE BOOKS:**

1. Hill & Peterson, "*Computer Aided Logical Design with Emphasis on VLSI*", John Wiley & Sons Pvt. Ltd, 4<sup>th</sup> edition, 1993.
2. Wayne Wolf, "*Modern VLSI Design Systems on silicon*", Pearson Education Asia, 2<sup>nd</sup> Edition, 1998.

**III B. Tech. – II Semester**  
**(19BT60411) ADVANCED DIGITAL COMMUNICATION SYSTEMS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Probability and Stochastic Processes.

**COURSE DESCRIPTION:** Characterization of Communication Signals and Systems, Digital Modulation Techniques, Optimum Receivers for the Additive Gaussian Noise Channel, Spread Spectrum Techniques, Multichannel and Multicarrier Systems.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1 : Demonstrate response of systems for Band Pass signal and signal space representations.
- CO2 : Analyze various digital Modulation Techniques to improve the performance of digital communication systems.
- CO3 : Analyze the performance of optimum receiver for Signals with Random Phase in AWGN Channel.
- CO4 : Apply Spread Spectrum techniques in Anti jamming Application, Low-Detectability Signal Transmission and Code Division Multiple Access.
- CO5 : Analyze the performance of Multichannel and Multicarrier systems.

**DETAILED SYLLABUS:**

**UNIT-I: CHARACTERIZATION OF COMMUNICATION SIGNALS AND SYSTEMS**  
**(08 Periods)**

Representation of Band Pass Signals and Systems–Representation of Band Pass Signals, Representation of Linear Band-Pass System, Response of a Band-Pass System to a Band-Pass Signal. Signal Space Representations – Vector Space Concepts, Signal Space Concepts, Orthogonal Expansion of Signals.

**UNIT-II: DIGITAL MODULATIONS** **(09 Periods)**

Digital Modulation – Factors that Influence the Choice of Digital Modulation, Bandwidth and Power Spectral Density of Digital Signals. Linear Modulation Techniques – BPSK, DPSK, QPSK, OQPSK,  $\pi/4$  QPSK. Constant Envelope Modulation Techniques – MSK, GMSK, Combined Linear and Constant Envelope Modulation Techniques – M-ary PSK, M-ary QAM.

**UNIT-III: OPTIMUM RECEIVERS FOR THE ADDITIVE GAUSSIAN NOISE CHANNEL**  
**(09 Periods)**

Optimum Receiver for Signals corrupted by AWGN –Correlation demodulator, Matched Filter Demodulator, Optimum Detector. Performance of the Optimum Receiver for Memory Less Modulation – Probability of Error for Binary Modulation, M-ary Orthogonal Signals, M-ary PAM, M-ary PSK, QAM. Optimum Receiver for Signals with Random Phase in AWGN Channel – Optimum Receiver for Binary Signals, Optimum Receiver for M-ary Orthogonal Signals.

**UNIT-IV: SPREAD SPECTRUM TECHNIQUES****(10 Periods)**

Introduction, Model of Spread Spectrum Digital Communication System, Direct Sequence Spread Spectrum Signals – Introduction, The Processing Gain and Jamming Margin. Applications of Direct Sequence Spread Spectrum Signals – Anti jamming Application, Low-Detectability Signal Transmission, Generation of PN-Sequences, Frequency-Hopped Spread Spectrum Signals, Other Types of Spread Spectrum Signals. Detection of spread spectrum signals- Matched filter receiver.

**UNIT-V:--MULTICHANNEL AND MULTICARRIER SYSTEMS****(09 Periods)**

Rayleigh and Rician channels, Multichannel Digital Communications in AWGN Channels; Binary Signals, M-ary Orthogonal Signals. Multicarrier Communications; Single Carrier versus Multicarrier Modulation, Capacity of a Non ideal Linear Filter Channel, OFDM, Modulation & Demodulation in an OFDM.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. John G. Proakis, "*Digital Communications*", McGraw Hill Education, 5th edition, 2014,

**REFERENCE BOOKS:**

1. Simon Haykin, "*Digital Communication Systems*", 4th edition, Wiley Publication, 2021
2. P Ramakrishna Rao , "*Communication systems*", McGraw Hill Education (India) (2013).

**ADDITIONAL LEARNING RESOURCES**

1. <https://nptel.ac.in/courses/108102096/>
2. [https://onlinecourses.nptel.ac.in/noc17\\_ec12/](https://onlinecourses.nptel.ac.in/noc17_ec12/)
3. <https://nptel.ac.in/courses/117105144/>
4. <https://nptel.ac.in/courses/117105144/5>

**III B. Tech. - II Semester**  
**(19BT60412) AUDIO SIGNAL PROCESSING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Digital signal Processing.

**COURSE DESCRIPTION:**

Audio Coding Architecture, Audio Coder Attributes, Linear Prediction for narrow and wide band coding, psychoacoustic and perceptual entropy, transform coding for high-fidelity audio signals, audio standards and audio quality matrices.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Apply linear prediction coding in wide band audio coding.

CO2: Analyze various masking's for Codec Perceptual Model-MPEG1.

CO3: Apply various transform coding in audio coding standards.

CO4: Analyze quality metrics to measure the quality of generated audio signals.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION**

**(09 Periods)**

A General Perceptual Audio Coding Architecture, Audio Coder Attributes, Types of Audio Coders, Linear Prediction coding- Short Term Linear Prediction, Open-Loop Analysis-Synthesis Linear Prediction, Analysis-by-Synthesis Linear Prediction, Linear Prediction in Wideband Audio Coding.

**UNIT-II: PSYCHOACOUSTIC PRINCIPLES**

**(09 Periods)**

Introduction, Absolute Threshold of Hearing, Critical Bands, Masking- Noise Masking Tone, Tone Masking Noise, Noise Masking Noise, Asymmetry of Masking; Non simultaneous Masking, Perceptual Entropy, Example Codec Perceptual Model-MPEG1; Perceptual Bit Allocation.

**UNIT-III: TRANSFORM CODERS**

**(09 Periods)**

Introduction, Optimum Coding in the Frequency Domain, Perceptual Transform Coder, Brandenburg-Johnston Hybrid Coder, CNET Coders, Adaptive Spectral Entropy Coding, Differential Perceptual Audio Coder, DFT Noise Substitution, DCT with Vector Quantization, MDCT with Vector Quantization.

**UNIT-IV: AUDIO CODING STANDARDS AND ALGORITHMS**

**(09 Periods)**

MIDI Versus Digital Audio, Multichannel Surround Sound, MPEG Audio Standards - MPEG1 Audio, MPEG2 BC, MPEG2 NBC, MPEG Surround and Spatial Audio Coding; Adaptive Transform Acoustic Coding (ATRAC), Lucent Technologies PAC, EPAC, Dolby Audio Coding Standards AC-2, Audio Processing Technology APT-x100, DTS - Coherent Acoustics.

## **UNIT-V: QUALITY MEASURES FOR PERCEPTUAL AUDIO CODING (09 Periods)**

Subjective Quality Measures, Confounding Factors in Subjective Evaluations, Subjective Evaluations of Two-Channel Standardized Codecs, Subjective Evaluations of 5.1-Channel Standardized Codecs, Subjective Evaluations Using Perceptual Measurement Systems- CIR Schemes, NSE Schemes; Algorithms for Perceptual Measurement- PAQM, NMR, OASE; Standards for Perceptual Quality Measurement.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

### **TEXT BOOK:**

1. Andreas Spanias Ted Painter Venkatraman Atti, *Audio Signal Processing and Coding*, John Wiley & Sons, Inc., Publications, 2007

### **REFERENCE BOOKS:**

1. Udo Zolzer, *Digital Audio Signal Processing*, ,John Wiley & Sons, Inc., Publications, 2<sup>nd</sup> Edition 2008
- 2 Francis F. Li and Trevor J. Cox, *Digital Signal Processing in Audio and Acoustical Engineering*, CRC Press, 2019.

**III B. Tech. – II Semester**  
**(19BT60413) NETWORK ON-CHIP DESIGN**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on VLSI Design.

**COURSE DESCRIPTION:** NOC –Architecture Design, Switching Technique; Routing Algorithm; Fault tolerance; Testing; 2D and 3D NOC.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze switching techniques and routing strategies in Network on-chip topologies to improve Quality of Service in communication applications.
- CO2: Design Router architectures for reliable communication in network on-chip designs.
- CO3: Develop routing algorithms to avoid deadlock problems in Routing Architecture.
- CO4: Apply test, fault tolerance, Power and monitoring strategies to reduce the occurrence of dead and Live lock condition during Fault tolerance.
- CO5: Analyze protocols for the development of 3D Network-On-Chip Architectures.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO NOC (08 Periods)**

Introduction to NoC, OSI layer rules in NoC, Interconnection Networks in Network-on-Chip Network Topologies, Switching Techniques, Routing Strategies, Flow Control Protocol, Quality-of-Service Support.

**UNIT-II: ARCHITECTURE DESIGN (08 Periods)**

Switching Techniques and Packet Format, Asynchronous FIFO Design, GALS Style of Communication, Wormhole Router Architecture Design, VC Router Architecture Design, Adaptive Router Architecture Design.

**UNIT-III: ROUTING ALGORITHM (08 Periods)**

Packet routing- Deadlock, Deadlock Recovery and Avoidance Livelock, QoS, congestion control and flow control, router design, network link design- Planar and Vertical Link, Routing Algorithms- Bufferless ,regular, Irregular Architectures.

**UNIT-IV: TEST AND FAULT TOLERANCE OF NOC (08 Periods)**

Test and Fault Tolerance Issues, Test Methods and Fault Models, Monitoring Services for Networks-on Chips- Monitoring Objectives and Opportunities, Monitoring Architecture and Information, Energy and Power Issues- Energy and Power Reduction Technology, Power Modeling Methodology.

## **UNIT-V: THREE-DIMENSIONAL INTEGRATION OF NETWORK-ON-CHIP**

**(08 Periods)**

Three-Dimensional Networks-on-Chips Architectures, Resource Allocation for QoS On-Chip Communication, Networks-on-Chip Protocols.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

### **TEXT BOOK:**

1. Chrysostomos Nicopoulos, Vijay krishnan Narayanan, Chita R.Das, "*Networks-on - Chip Architectures Holistic Design Exploration*", Springer, 2009.

### **REFERENCES:**

1. Fayezge bali, Haythameliligi, Hqhahed Watheq E1-Kharashi, *Networks-on-Chips theory and practice*, CRC press, 1<sup>st</sup> Edition, 2009.
2. Konstantinos Tatas and Kostas Siozios, *Designing 2D and 3D Network-on-Chip Architectures*, 2013.
3. Palesi, Maurizio, Daneshtalab, Masoud *Routing Algorithms in Networks-on-Chip*, 2014.
4. Santanu Kundu, Santanu Chattopadhyay, *Network-on-Chip: The Next Generation of System on-Chip Integration*, CRC Press, 2018.

### **ADDITIONAL LEARNING RESOURCES**

1. <https://www.hindawi.com/journals/jece/2012/509465/>
2. <https://nptel.ac.in/courses/106103183/22>



### **III B. Tech. – II Semester** **(19BT60414) RFIC DESIGN**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on VLSI Design

#### **COURSE DESCRIPTION:**

Basics of RF IC Design, Assessment Parameters, Transceiver Architectures, Low Noise Amplifiers, Mixers, Oscillators, Phase Locked Loop, Power Amplifiers.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the effects of Nonlinearity and metrics in the evaluation of RF IC Designs.
- CO2: Analyze various architectures and components of transceivers in RF systems.
- CO3: Solve input matching problems and considerations for the development of Low Noise Amplifiers and Mixers.
- CO4: Apply various design Techniques to improve the performance of oscillators.
- CO5: Design Phase Locked Loops and Power Amplifiers to overcome non idealities for efficient operation at wide range of RF frequencies.

#### **DETAILED SYLLABUS:**

##### **UNIT-I: BASIC CONCEPTS IN RF IC DESIGN (07 Periods)**

Introduction to RF Design, Units in RF design, Time Variance and Nonlinearity, Effects of nonlinearity, random processes and Noise, Definitions of sensitivity and dynamic range, Passive impedance transformation, Scattering parameters.

##### **UNIT-II: TRANSCEIVER ARCHITECTURES (11 Periods)**

General considerations, Receiver Architectures - Basic Heterodyne receivers, Modern heterodyne receivers, Direct conversion receivers, Image-Reject receivers, Low-IF receivers. Transmitter Architectures - Direct Conversion transmitters, Modern direct conversion Transmitters, Heterodyne Transmitters.

##### **UNIT-III: LNA AND MIXERS (10 Periods)**

General considerations, Problem of input matching, Low Noise Amplifiers design topologies, Gain Switching, Band Switching, Mixers - General considerations, Passive down conversion mixers, Active down conversion mixers, Up conversion mixers.

##### **UNIT-IV: OSCILLATORS (08 Periods)**

Performance parameters, Basic principles, Cross coupled oscillator, Three point oscillators, Voltage Controlled Oscillators, phase noise, Quadrature Oscillators.

**UNIT-V: PLL AND POWER AMPLIFIERS****(09 Periods)**

PLLs - Phase detector, Type-I PLLs, Type-II PLLs, PFD/CP Non idealities, Phase noise in PLLs. Power Amplifiers - General considerations, Classification of power amplifiers, High - Efficiency power amplifiers, Linearization techniques.

**Total Periods: 45*****Topics for Self-Study are provided in the Lesson Plan*****TEXT BOOK:**

1. B. Razavi, "*RF Microelectronics*", Prentice-Hall PTR, 2nd Edition, 2011.

**REFERENCE BOOKS:**

1. T. H. Lee, "*The Design of CMOS Radio-Frequency Integrated Circuits*", Cambridge University Press, 2<sup>nd</sup> Edition, 2004.
2. R. Jacob Baker, Harry W. Li, D.E. Boyce, "*CMOS Circuit Design, Layout and Simulation*", Wiley-IEEE Press, 4<sup>th</sup> Edition, 2019.

**ADDITIONAL LEARNING RESOURCES:**

<http://www.mhhe.com/engcs/electrical/razavi/ppt.mhtml>

<https://nptel.ac.in/courses/117102012/>

**IV B. Tech. - I Semester**  
**(19BT70410) ADVANCED WIRELESS COMMUNICATIONS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** Courses on Analog Communications and Digital Communications

**COURSE DESCRIPTION:** Introduction to wireless communication systems and cellular concept, Large and Small signal Propagation models, Equalization & Diversity techniques, Multiple access and Multiple Input and Multiple Output (MIMO) systems

**COURSE OUTCOMES:** After successful completion of this course, students will be able to

- CO1: Demonstrate the concepts of wireless communications and cellular systems
- CO2: Analyze the characteristics of mobile radio propagation channels.
- CO3: Apply appropriate equalization & diversity techniques for wireless communication systems
- CO4: Apply various multiple access techniques for narrow and wideband systems.
- CO5: Design MIMO systems for advanced wireless communications

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO WIRELESS COMMUNICATION SYSTEMS**

**(09 Periods)**

History of Wireless Communications, Wireless Vision, Technical Issues; Current Wireless Systems - Cellular Telephone Systems, Cordless Phones, Wireless Local Area Networks, Wide Area Wireless Data Services, Broadband Wireless Access, Paging Systems, Satellite Networks, Low-Cost & Low-Power Radios - Bluetooth and ZigBee, Ultrawideband Radios; Wireless Spectrum - Methods for Spectrum Allocation, Spectrum Allocations for Existing Systems; Standards.

**UNIT-II: MOBILE RADIO PROPAGATION**

**(09 Periods)**

**Large Scale Path Loss:** Introduction, Free Space Propagation Model, Relating Power to Electric field, Propagation Mechanisms – Reflection, Diffraction, and Scattering. Outdoor and Indoor Environment Propagation Models, Practical Budget Design using Path Loss Models.

**Small Scale Fading and Multipath:** Small Scale Multipath Propagation, Impulse Response Model of a Multipath Channel, Small Scale Multipath Measurements, Parameters of Mobile Channels, Types of Small Scale Fading.

**UNIT-III: EQUALIZATION & DIVERSITY TECHNIQUES**

**(09 Periods)**

**Equalization:** Introduction, Survey of Equalization Techniques, Linear and Non-linear Equalizers – Linear Transversal Equalizer, Decision Feedback Equalizer (DFE).

**Diversity Techniques:** Realization of Independent Fading Paths, Receiver Diversity – System Model, Selection Combining, Threshold Combining, Maximal Ratio Combining, and Equal Gain Combining, Rake receiver. Transmit Diversity–Channel known at Transmitter, Channel unknown at Transmitter – Alamouti Scheme, analysis.

**UNIT-IV: MULTIPLE ACCESS TECHNIQUES****(09 Periods)**

**Narrowband cellular systems:** GSM system, Impact on network and system design, Impact on frequency reuse.

**Wideband systems:** CDMA, CDMA uplink, CDMA downlink, System issues, **OFDM:** Allocation design principles, Hopping pattern, Signal characteristics and receiver design, Sectorization

**UNIT-V: Multiple Input Multiple Output (MIMO) Systems****(09 Periods)**

Introduction to MIMO, MIMO Channel Capacity, SVD and Eigen modes of the MIMO Channel, MIMO Spatial Multiplexing - BLAST, MIMO Diversity - OSTBC, MRT, Applications of MIMO - OFDM.

**Total periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. T. S. Rappaport, "Wireless Communications: Principles and Practice," Pearson Education, 2<sup>nd</sup> Edition, 2010.
2. David Tse, Pramod Viswanath, "Fundamentals of Wireless Communication," Cambridge University Press, 2005.
3. Andrea Goldsmith, "Wireless Communications," Cambridge University Press, 2005.

**REFERENCE BOOKS:**

1. Aditya K. Jagannatham, "Principles of Modern Wireless Communications Systems – Theory and Practice", McGraw-Hill International, 2017.
2. William C.Y. Lee, "Wireless and Cellular Telecommunications," 3<sup>rd</sup> edition, McGraw Hill, 2006.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/117/104/117104099/>
2. <https://nptel.ac.in/courses/117/104/117104115/>
3. <https://nptel.ac.in/courses/117/105/117105132/>

**IV B. Tech. - I Semester**  
**(19BT70411) OPTICAL NETWORKS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:**

Introduction to Optical Networks, Transmission System Engineering, Client Layers of Optical Layer, WDM, Network Elements and Design, Network Topologies and Protection Schemes

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate the Optical networks, management techniques and functions.
- CO2: Analyze Optical Amplifiers and Wavelength Conversion for Overall Design Considerations of optical networks
- CO3: Solve problems in signaling and Routing for optical layers
- CO4: Design optical network elements for routing networks

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO OPTICAL NETWORKS (09 Periods)**

Telecommunications Networks Architecture, Services, circuit switching and packet switching, Optical Networks, The Optical Layer, Transparency and All-Optical Networks, Optical Packet Switching, Transmission Basics, Network Evolution,

**UNIT-II: TRANSMISSION SYSTEM ENGINEERING (09 Periods)**

System Model, Power Penalty, Transmitter, Receiver, Optical Amplifiers - Gain Saturation in EDFAs, Gain Equalization in EDFAs, Amplifier Cascades, Amplifier Spacing Penalty, Power Transients and Automatic Gain Control, Lasing Loops, Crosstalk - Intra and inter channel crosstalk, crosstalk in networks, crosstalk reduction, Dispersion- Chromatic Dispersion Limits: NRZ and RZ Modulation, Wavelength Stabilization, Design of Soliton Systems, Design of Dispersion-Managed Soliton Systems, Overall Design Considerations- Fiber type, Transmitter power and Amplifier Spacing.

**UNIT-III: CLIENT LAYERS OF OPTICAL LAYER (09 Periods)**

SONET and SDH – multiplexing, VCAT and LCAS, SONET/SDH Layers, SONET Frame Structure, SONET/SDH Physical Layers, Elements of a SONET/SDH Infrastructure, Optical Transport Networks -hierarchy, Frame structure, multiplexing, Generic Framing Procedure (GFP), IP- Routing and Forwarding, Quality of Service, Multiprotocol label switching-Labels and forwarding Quality of service, Signaling and Routing, Carrier Transport, Storage area networks-Fibre Channel.

**UNIT-IV: WDM, NETWORK ELEMENTS AND DESIGN****(09 Periods)**

Optical line terminals, Optical line amplifiers, Optical Add/Drop Multiplexers-OADM Architectures, Reconfigurable OADMs, Optical Cross connectors - All optical cross connectors Cost Trade-Offs: A detailed ring network example, LTD and RWA Problems- Light path topology Design, Routing and Wavelength Assignment, Wavelength Conversion, Dimensioning Wavelength-Routing Networks, Statistical Dimensioning Models, First-Passage Model, Blocking Model, Maximum load Dimensioning Models- Offline light path Requests, Online RWA in Rings

**UNIT-V: NETWORK TOPOLOGIES AND PROTECTION SCHEMES, MPLS AND OPTICAL NETWORKS****(09 Periods)**

Robust networks, Line and path protection switching, Types of topology, Point to point topology, bi-directional line-switched ring (BLSR), meshed topology, Passive optical networks, Metro optical networks 28 MPLS and Optical Networks: IS label switching, Forwarding equivalence class (FEC), Types of MPLS nodes, Label distribution and binding, label swapping and traffic forwarding, MPLS support of Virtual Private Networks (VPN), MPLS traffic engineering, Multi protocol Lambda switching (MPIS).

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOKS:**

1. Rajiv Ramaswami and Kumar Sivarajan, "*Optical Networks-Practical Perspective*", 3rd Edition, Morgan - Kaufmann Publishers (ELSEVIER), 2010 ISBN: 978-0-12-374092-2.
2. Uyless Black, "*Optical Networks:Third Generation Transport Systems*", Pearson India,2008.

**REFERENCE BOOKS:**

1. Partha Pratim Sahu, "*Fundamentals of Optical Networks and Components*", CRC Press, July 10, 1st Edition, 2020. ISBN 9780367265458
2. Mukherjee, B., Tomkos, I., Tornatore, M., Winzer, P., Zhao, Y. (Eds.), "*Springer Handbook of Optical Networks*", 1st Edition, 2020. ISBN 978-3-030-16250-4.

**ADDITIONAL LEARNING RESOURCES:**

1. Mohammad Ilyas and Hussein T. Mouftah, "The Handbook of Optical communication networks", CRC Press.
2. [https://onlinecourses.nptel.ac.in/noc20\\_ee79](https://onlinecourses.nptel.ac.in/noc20_ee79)

**IV B. Tech. - I Semester**  
**(19BT70412) PATTERN RECOGNITION**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Digital Image processing.

**COURSE DESCRIPTION:** Importance of pattern recognition; Baye's Decision Theory; Linear and non linear classifiers; Feature selection based on statistical hypothesis testing; Feature Generation; KL Transform; SVD; ICA; Clustering of features and clustering algorithms.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to

- CO1: Analyze probability density function between the patterns using bayes classifier for supervised learning.
- CO2: Estimate cost function and minimum mean square error between the pattern classes using linear and Non-Linear classifier algorithms such as LMS, Support Vector Machine and back propagation algorithms.
- CO3: Apply feature selection and generation techniques to identify features and separate objects in an image.
- CO4: Apply clustering techniques to identify various patterns in societal Applications.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO PATTERN RECOGNITION (10 Periods)**

Importance of pattern recognition, Features, Feature Vectors and Classifiers, Supervised, Unsupervised and Semi Supervised Learning. Classifiers based on Baye's Decision Theory - Baye's decision theory, Discriminant Functions and decision surfaces, Bayesian classification for Normal Distributions, Estimation of Unknown probability density functions, The Nearest Neighbor Rule.

**UNIT-II: LINEAR CLASSIFIERS (09 Periods)**

Linear Discriminant functions and Decision Hyperplanes, The perceptron Algorithm, Least Squares Method- Mean Square Error Estimation, Stochastic Approximation and the LMS Algorithm, Sum of Error Squares Estimation Least Squares Method; Mean Square Estimation Revisited- Mean Square Error Regression; Support Vector Machine- Separable classes, Nonseparable classes

**UNIT-III: NON LINEAR CLASSIFIERS (09 Periods)**

The XOR problem, The two layer perceptron, Three layer perceptrons, The Back propagation Algorithm, The cost function choice, choice of the network size, A simulation example, Networks with weight sharing, generalized linear classifiers, polynomial classifiers, Radial basis Function Networks.

**UNIT-IV: FEATURE SELECTION & GENERATION****(09 Periods)**

Feature Selection- Pre processing, The peaking phenomenon, Feature selection based on statistical hypothesis testing, ROC curve, class separability measures, feature subset selection; Feature Generation - Basis Vectors and Images, The KL Transform, The Singular Value Decomposition, Independent Component Analysis, Non negative Matrix Factorization, Regional features, Features for shape and size characterization.

**UNIT-V: CLUSTERING****(08 Periods)**

Introduction, Types of Features, Definitions of Clustering, Proximity Measures-Proximity Measures between Two Points, Proximity Functions between a Point and a Set, Proximity Functions between Two Sets; Categories of Clustering Algorithms, Sequential Clustering Algorithms, A Modification of BSAS, A Two-Threshold Sequential Scheme, Refinement Stages.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOK:**

1. Sergios Theodoridis, Konstantinos Koutroumbas, *Pattern Recognition*, Academic Press, Second Edition, 2009.

**REFERENCE BOOKS:**

1. Richard Duda, Peter E Hart, David G Stork, *Pattern Classification*, John Wiley & Sons, Second Edition, 2001.
2. Christopher M.Bishop, *Pattern Recognition and Machine Learning*, Springer Publications, 2006.



**IV B. Tech. - I Semester**  
**(19BT70413) VLSI SIGNAL PROCESSING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** Courses on VLSI Design and Digital Signal Processing

**COURSE DESCRIPTION:**

Introduction to Typical DSP Algorithms, Data Flow graph Representations, Iteration Bound, The Minimum Cycle Mean Algorithm, Pipelining and Parallel Processing techniques, Retiming concepts, Fast Convolution, Arithmetic Strength Reduction techniques for Filter design, Pipelining and Parallel Processing for design of IIR Filters.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze various DSP algorithms to design digital and adaptive Filter Banks to improve performance characteristics of digital systems in multidisciplinary environments such as image processing, wireless communication, biomedical engineering, speech processing, video processing, etc
- CO2: Analyze iterative bound, parallel and pipelining processing methods in the frequency analysis of FIR filters.
- CO3: Understand convolution methods and arithmetic strength reductions in analyzing Parallel FIR filters.
- CO4: Design IIR filters by applying pipelining and parallel processing techniques.
- CO5: Analyze scaling and round off noise to evaluate the performance of digital filters.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO DIGITAL SIGNAL PROCESSING (07 Periods)**

Typical DSP Algorithms – Convolution, Correlation, Digital Filters, Adaptive Filters. Representation of DSP Algorithms - Block Diagrams, Signal-Flow Graph, Data-Flow Graph.

**UNIT-II: ITERATION BOUND, PIPELINING AND PARALLEL PROCESSING OF FIR FILTER (08 Periods)**

**Iteration Bound** - Data-Flow Graph Representations, Loop Bound and Iteration Bound, Algorithms for Computing Iteration Bound-Longest Path Matrix Algorithm, The Minimum Cycle Mean Algorithm.

**Pipelining and Parallel Processing** - Pipelining of FIR Digital Filters. Parallel Processing, Pipelining and Parallel Processing for Low Power.

**Retiming** – Definitions and Properties, Solving Systems of Inequalities, Retiming Techniques.

### **UNIT-III: FAST CONVOLUTION AND ARITHMETIC STRENGTH REDUCTION IN FILTERS (10 Periods)**

**Fast Convolution** - Cook-Toom Algorithm, Modified Cook-Toom Algorithm, Design of Fast Convolution Algorithm by Inspection.

Parallel FIR filters, Fast FIR algorithms - Two parallel and three parallel fast FIR algorithms. Low- Complexity FIR Filters. Parallel architectures for Rank Order filters – Odd-Even Merge-Sort architecture, Rank Order filter architectures, Parallel Rank Order filters, Running Order Merge – Sorter, Low power Rank Order filter.

### **UNIT-IV: PIPELINED AND PARALLEL RECURSIVE FILTERS (10 Periods)**

Pipeline Interleaving in Digital Filters, Pipelining in 1<sup>st</sup>Order IIR Digital Filters, Pipelining in Higher-Order IIR Digital Filters-Clustered Look-Ahead Pipelining, Stable Clustered Look-Ahead Filter Design. Parallel Processing for IIR Filters.

### **UNIT-V: SCALING AND ROUND OFF NOISE (10 Periods)**

Scaling and Round off Noise, State Variable Description of Digital Filters, Scaling and Round off Noise Computation, Round off Noise Computation Using State Variable Description, Slow-Down, Retiming and Pipelining.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOK:**

1. K.K Parhi, "VLSI Digital Signal processing", John Wiley, 1999.

#### **REFERENCE BOOKS:**

1. John G.Proakis, Dimitris G.Manolakis, "Digital Signal Processing", Prentice Hall of India, Fourth Edition, 2007.
2. George A. Constantinides, Peter Y.K. Cheung, Wayne Luk, "Synthesis and Optimization of DSP Algorithms", Kluwer Academic Publishers, 2004.

# **MINOR DEGREE**

**(SVEC-19 Regulations)**

## **MINOR DEGREE IN ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**

**Offering Department:** Computer Science and Engineering

**Students of Eligible Branches:** ECE, EEE, EIE, ME and CE

### **COURSE STRUCTURE**

| Year<br>&Semester                                  | Course<br>Code | Course Title                   | Contact Periods per<br>week |   |   |       | C | Scheme of<br>Examination<br>Max. Marks |               |                |
|----------------------------------------------------|----------------|--------------------------------|-----------------------------|---|---|-------|---|----------------------------------------|---------------|----------------|
|                                                    |                |                                | L                           | T | P | Total |   | Int.<br>Marks                          | Ext.<br>Marks | Total<br>Marks |
| III B.Tech.<br>I-Sem<br><br>(2 Theory +<br>1 Lab)  | 19BT50502      | Artificial Intelligence        | 3                           | - | - | 3     | 3 | 40                                     | 60            | 100            |
|                                                    | 19BT60505      | Soft Computing                 | 3                           | - | - | 3     | 3 | 40                                     | 60            | 100            |
|                                                    | 19BT50507      | Python for Data Science        | 3                           | - | - | 3     | 3 | 40                                     | 60            | 100            |
|                                                    | 19BT50534      | Python for Data Science<br>Lab | -                           | - | 2 | 2     | 1 | 50                                     | 50            | 100            |
| III B.Tech.<br>II-Sem<br><br>(2 Theory +<br>1 Lab) | 19BT70502      | Data Science                   | 3                           | - | - | 3     | 3 | 40                                     | 60            | 100            |
|                                                    | 19BT60507      | Nature Inspired<br>Algorithms  | 3                           | - | - | 3     | 3 | 40                                     | 60            | 100            |
|                                                    | 19BT60502      | Machine Learning               | 3                           | - | - | 3     | 3 | 40                                     | 60            | 100            |
|                                                    | 19BT60531      | Machine Learning<br>Lab        | -                           | - | 2 | 2     | 1 | 50                                     | 50            | 100            |
| IV B.Tech.<br>I-Sem<br><br>(1 Theory +<br>1 Lab)   | 19BT71503      | Deep Learning                  | 3                           | - | - | 3     | 3 | 40                                     | 60            | 100            |
|                                                    | 19BT70533      | Deep Learning Lab              | -                           | - | 2 | 2     | 1 | 50                                     | 50            | 100            |

**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

**III B. Tech. – I Semester**  
**(19BT50502) ARTIFICIAL INTELLIGENCE**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to artificial intelligence, Designing intelligent agents, Solving general purpose problems, Search in complex environments, Probabilistic reasoning, Represent knowledge and reason under uncertainty, Robotics, Ethics and safety in AI.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Architect intelligent agents using artificial intelligence techniques and principles.
- CO2: Analyze and interpret the problem, identify suitable solutions using heuristic functions, optimization algorithms and search algorithms.
- CO3: Select and apply appropriate knowledge representation to build Bayesian network models to reason under uncertainty.
- CO4: Investigate robot hardware and frameworks for intelligent robotic perception.
- CO5: Demonstrate knowledge on ethical implications of intelligent machines for providing privacy, trust, security and safety.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO ARTIFICIAL INTELLIGENCE (10 Periods)**

Foundations of artificial intelligence, History of artificial intelligence, State of the art, Risks and benefits of AI, Intelligent agents – Agents and environments, The concept of rationality, Structure of agents.

**UNIT-II: PROBLEM SOLVING BY SEARCHING (09 Periods)**

Problem solving agents, Search algorithms, Uninformed search strategies, Informed search strategies – Greedy best-first search, A\* search; Heuristic functions.

**UNIT-III: SEARCH IN COMPLEX ENVIRONMENTS (09 Periods)**

Local search algorithms and optimization problems – Hill-climbing search, Simulated annealing, Local beam search, Evolutionary algorithms; Optimal decisions in games – The minimax search algorithm, Optimal decisions in multiplayer games, Alpha-Beta pruning, Move ordering; Monte Carlo tree search.

**UNIT-IV: PROBABILISTIC REASONING (09 Periods)**

Representing Knowledge in an uncertain domain, Semantics of Bayesian networks, Probabilistic reasoning over time – Time and uncertainty, Inference in temporal models, Hidden Markov models, Kalman Filter.

**UNIT-V: ROBOTICS, ETHICS AND SAFETY IN AI (08 Periods)**

**Robotics:** Robots, Robot hardware, Robotic perception, Alternative robotic frameworks, Application domains.

**Ethics and Safety in AI:** Limits of AI, Ethics of AI – Surveillance, security and privacy, Fairness and bias, Trust and transparency, AI safety.

**Total Periods: 45**

**Topics for self-study are provided in the lesson plan**

**TEXT BOOK:**

1. Stuart Russell, Peter Norvig, *Artificial Intelligence: A Modern Approach*, Prentice Hall, 4<sup>th</sup> Edition, 2020.

**REFERENCE BOOKS:**

1. Stephen Lucci, Danny Kopec, *Artificial Intelligence in the 21<sup>st</sup> Century*, Mercury Learning and Information, 3<sup>rd</sup> Edition, 2018.
2. Rich, Knight, Nair, *Artificial intelligence*, Tata McGraw Hill, 3<sup>rd</sup> Edition, 2009.
3. Deepak Khemani, *A First Course in Artificial Intelligence*, McGraw Hill, 2017.
4. Saroj Kaushik, *Artificial Intelligence*, Cengage Learning, 2011.

**ADDITIONAL RESOURCES:**

- <https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence>
- <http://aima.cs.berkeley.edu/>
- <https://ai.google/education/>
- <https://www.coursera.org/courses?query=artificial%20intelligence>
- <https://www.edureka.co/blog/artificial-intelligence-with-python/>

**III B. Tech. – I Semester**  
**(19BT60505) SOFT COMPUTING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Soft computing technique concepts, Supervised learning networks, Unsupervised learning networks, Genetic algorithms, Fuzzy logic, Hybrid soft computing techniques and applications.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Investigate soft computing techniques for solving computational problems.
- CO2: Design efficient neural architectures to model patterns for a given learning problem.
- CO3: Investigate and solve optimization problems using genetic algorithms.
- CO4: Apply fuzzy logic and reasoning to handle uncertainty in engineering problems.
- CO5: Develop intelligent solutions using hybrid soft computing techniques to solve problems of multidisciplinary domains.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO SOFT COMPUTING AND SUPERVISED LEARNING NETWORKS (10 Periods)**

**Introduction to Soft Computing:** Neural networks, Application scope of neural networks, Fuzzy logic, Genetic algorithm, Hybrid systems, Soft computing.

**Artificial Neural Networks:** Fundamentals, Basic Models, Terminologies, Linear Separability, Hebb network.

**Supervised Learning Networks:** Perceptron Networks- Theory, Perceptron learning rule, Architecture, Flowchart for training process, Perceptron training algorithm for single and multiple output classes, Perceptron network testing algorithm; Back-Propagation Network - Theory, Architecture, Flow chart for training process, Training algorithm, Learning factors of back-propagation network, Testing algorithm for back-propagation network.

**UNIT-II: UNSUPERVISED LEARNING NETWORKS (08 Periods)**

Fixed weight competitive nets – Maxnet, Mexican Hat Net, Hamming network; Kohonen self-organizing feature maps – Theory, Architecture, Flowchart, Training algorithm; Learning vector quantization – Theory, Architecture, Flowchart, Training algorithm, Variants; Counterpropagation networks – Theory, Full counterpropagation Net, Forward-only counterpropagation Net; Adaptive resonance theory network – Fundamental architecture, Fundamental operating principle, Fundamental algorithm.

**UNIT-III: GENETIC ALGORITHMS (09 Periods)**

Genetic algorithms - Biological background, Traditional optimization and search techniques, Genetic algorithm and search space, Genetic algorithms vs. traditional algorithms, Basic terminologies in genetic algorithm, Simple GA, General genetic algorithm, Operators in genetic algorithm, Stopping condition for genetic algorithm flow, Constraints in genetic algorithm, Problem solving using genetic algorithm, Adaptive

genetic algorithms, Hybrid genetic algorithms, Advantages and limitations of genetic algorithm, Applications of genetic algorithm.

#### **UNIT-IV: FUZZY LOGIC**

**(11 Periods)**

Introduction to fuzzy logic, Classical sets, Fuzzy sets, Membership function – Features, Fuzzification, Methods of membership value assignments; Fuzzy arithmetic and measures – Fuzzy arithmetic, Extension principle, Fuzzy measures, Measures of fuzziness, Fuzzy integrals; Fuzzy rule base and approximation reasoning - Truth values and tables in fuzzy logic, Fuzzy propositions, Formation of rules, Compound rules, Aggregation of fuzzy rules, Fuzzy reasoning, Fuzzy inference systems, Overview of fuzzy expert system; Fuzzy decision making, Fuzzy logic control systems.

#### **UNIT-V: HYBRID SOFT COMPUTING TECHNIQUES AND APPLICATIONS**

**(07 Periods)**

**Hybrid Soft Computing Techniques:** Genetic neuro hybrid systems, Genetic fuzzy hybrid and fuzzy genetic hybrid systems.

**Applications of Soft Computing:** Optimization of traveling salesman problem using genetic algorithm approach, Genetic algorithm-based internet search technique, Soft computing-based hybrid fuzzy controllers, Soft computing-based rocket engine control.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

#### **TEXT BOOK:**

1. S. N. Sivanandam and S. N. Deepa, *Principles of Soft Computing*, Wiley, 3<sup>rd</sup> Edition, 2019.

#### **REFERENCE BOOKS:**

1. S. Rajasekaran and G. A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Logic and Genetic Algorithms: Synthesis and Applications*, PHI Learning Private Ltd, 2011.
2. Udit Chakraborty, Samir Roy, *Soft Computing: Neuro-Fuzzy and Genetic Algorithms*, Pearson, 2013.
3. Saroj Kaushik, Sunita Tewari, *Soft Computing: Fundamentals, Techniques and Applications*, McGraw Hill, 2018.

#### **ADDITIONAL LEARNING RESOURCES:**

- <https://nptel.ac.in/courses/106105173/>



**III B. Tech. – I Semester**  
**(19BT50507) PYTHON FOR DATA SCIENCE**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Basics of Data Science, Computation using NumPy, Data exploration using Pandas, Data transformation, Plotting and visualization using Matplotlib, Time series analysis.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on the concepts of data science to perform mathematical computations using efficient storage and data handling methods in NumPy.
- CO2: Apply data preparation and exploration methods using Pandas to perform data manipulation.
- CO3: Create data visualization using charts, plots and histograms to identify trends, patterns and outliers in data using Matplotlib and Seaborn.
- CO4: Develop methods to analyze and interpret time series data to extract meaningful statistics.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION (10 Periods)**

Basic terminologies of data science, Types of data, Five steps of data science, The NumPy ndarray, Fast element-wise array functions, Array-oriented programming with arrays, File input and output with arrays, Linear algebra, Pseudorandom number generation.

**UNIT-II: DATA EXPLORATION WITH PANDAS (10 Periods)**

Process of exploring data, Pandas data structures – Series, Data frame, Index objects; Essential functionality, Summarizing and computing descriptive statistics, Data loading, storage, and file formats – Reading and writing data in text format, Reading text files in pieces, Writing data to text format; Reading Microsoft Excel files.

**UNIT-III: DATA CLEANING AND PREPARATION (08 Periods)**

Handling missing data – Filtering out missing data, Filling in missing data; Data transformation – Removing duplicates, Transforming data using a function or mapping, Replacing values, Renaming axis indexes, Discretization and binning, Detecting and filtering outliers, Permutation and random sampling, Computing indicator/dummy variables; String manipulation – String object methods, Regular expressions, Vectorized string functions in Pandas.

**UNIT-IV: DATA VISUALIZATION WITH MATPLOTLIB (08 Periods)**

Plotting with Matplotlib – Figures and subplots, Colors, markers and line styles, Ticks, labels and legends, Annotations and drawing on a subplot, Saving plots to file; Plotting with Pandas and Seaborn – Line plots, Bar plots, Histograms and density plots, Scatter plots, Facet grids and categorical data.

**UNIT–V: TIME SERIES ANALYSIS****(09 Periods)**

Date and time data types and tools, Time series basics, Date ranges, frequencies, and shifting, Time zone handling, Periods and period arithmetic, Resampling and frequency conversion, Moving window functions.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOK:**

1. Wes McKinney, *Python for Data Analysis*, O'Reilly, 2<sup>nd</sup> Edition, 2017.

**REFERENCE BOOKS:**

1. Sinan Ozdemir, *Principles of Data Science*, Packt Publishers, 2<sup>nd</sup> Edition, 2018.
2. John Paul Mueller, Luca Massaron, *Python for Data Science for Dummies*, 2<sup>nd</sup> Edition, Wiley, 2015.
3. Rachel Schutt, Cathy O'Neil, *Doing Data Science: Straight Talk from the Frontline*, O'Reilly, 2014.

**ADDITIONAL LEARNING RESOURCES:**

- [https://swayam.gov.in/nd1\\_noc19\\_cs60/preview](https://swayam.gov.in/nd1_noc19_cs60/preview)
- <https://towardsdatascience.com/>
- <https://www.w3schools.com/datascience/>
- <https://github.com/jakevdp/PythonDataScienceHandbook>
- <https://www.kaggle.com>

**III B. Tech. – I Semester**  
**(19BT50534) PYTHON FOR DATA SCIENCE LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A Course on “Python for Data Science”

**COURSE DESCRIPTION:** Hands on practice on the concepts of data science using Python - Computations using NumPy, Data manipulation using Pandas, Data cleaning and preparation, Data visualization using Matplotlib and Seaborn, Time series analysis.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate efficient storage and data handling methods in NumPy to perform mathematical computations vital for data science.
- CO2: Apply data preparation and data exploration methods using Pandas to perform data manipulation.
- CO3: Create data visualization using charts, plots and histograms to identify trends, patterns and outliers in data importing Matplotlib and Seaborn.
- CO4: Develop methods to analyze and interpret time series data to extract meaningful statistics.
- CO5: Work independently to solve problems with effective communication.

**LIST OF EXERCISES:**

1. Array Computations using NumPy
  - a) Perform arithmetic operations using array.
  - b) Perform slicing and indexing on multi-dimensional arrays.
  - c) Perform computations on multi-dimensional array using universal functions (ufunc).
  - d) Compute arithmetic mean, standard deviation, variance, percentile, minimum and maximum, cumulative sum and product using statistical functions in NumPy.
  - e) Perform set theory operations such as union, intersection, symmetric difference and fetching unique values.
2. Linear Algebra and Random Number generation using linalg and random module in NumPy
  - a) Compute dot product, vector product and inner product of two arrays.
  - b) Perform matrix operations such as multiplication, determinant, sum of diagonal elements and inverse.
  - c) Compute eigenvalues, eigenvectors and singular value decomposition for a square matrix.
  - d) Generate random samples from uniform, normal, binomial, chi-square and Gaussian distributions using numpy.random functions.
  - e) Implement a single random walk with 1000 steps using random module and extract the statistics like minimum and maximum value along the walk's trajectory.

3. Data Manipulation using pandas
  - a) Create DataFrame from List, Dict, List of Dicts, Dicts of Series and perform operations such as column selection, addition, deletion and row selection, addition and deletion.
  - b) Create a DataFrame and perform descriptive statistics functions such as sum, mean, median, mode, standard deviation, skewness, kurtosis, cumulative sum, cumulative product and percent changes.
  - c) Implement the computation of correlation and covariance by considering the DataFrames of stock prices and volumes obtained from Yahoo Finance! Using pandas-datareader package.
4. Working with different data formats using pandas
  - a) Perform reading and writing data in text format using read\_csv and read\_table considering any online dataset in delimited format (CSV).
  - b) Perform reading and writing of Microsoft Excel Files (xlsx) using read\_excel.
5. Data Cleaning and Preparation
  - a) Perform data cleaning by creating a DataFrame and identifying missing data using NA(Not Available) handling methods, filter out missing data using dropna function, fill the missing data using fillna function and remove duplicates using duplicated and drop\_duplicates functions.
  - b) Perform data transformation by modifying set of values using map and replace method and create transformed version of original dataset without modification using rename method.
  - c) Create a DataFrame with normally distributed data using random sampling and detect possible outliers.
6. Perform Data Visualization with Matplotlib and Seaborn considering online dataset for processing.
  - a) Create a Line Plot by setting the title, axis labels, ticks, ticklabels, annotations on subplots and save to a file.
  - b) Create Bar Plots using Series and DataFrame index.
    - i) Create bar plots with a DataFrame to group the values in each row together in a group in bars side by side for each value.
    - ii) Create stacked bar plots from a DataFrame.
  - c) Create Histogram to display the value frequency and Density Plot to generate continuous probability distribution function for observed data.
  - d) Create Scatter Plot and examine the relationship between two one-dimensional data series.
  - e) Create Box plots to visualize data with many categorical variables.
7. Time Series Analysis
  - a) Create time series using datetime object in pandas indexed by timestamps.
  - b) Use pandas.date\_range to generate a DatetimeIndex with an indicated length.
  - c) Perform period arithmetic such as adding and subtracting integers from periods and construct range of periods using period\_range function.
  - d) Convert Series and DataFrame objects indexed by timestamps to periods with the to\_period method.
  - e) Perform resampling, downsampling and upsampling for the time series.

**REFERENCE BOOKS:**

1. Wes McKinney, *Python for Data Analysis*, O'Reilly, 2<sup>nd</sup> Edition, 2017.
2. John Paul Mueller, Luca Massaron, *Python for Data Science For Dummies*, 2<sup>nd</sup> Edition, Wiley, 2015.

**SOFTWARE/TOOLS:**

- Python 3.8
- Python Libraries – NumPy, Pandas, Matplotlib,
- Anaconda Framework

**ADDITIONAL LEARNING RESOURCES:**

- [https://swayam.gov.in/nd1\\_noc19\\_cs60/preview](https://swayam.gov.in/nd1_noc19_cs60/preview)
- <https://towardsdatascience.com/>
- <https://www.w3schools.com/datascience/>
- <https://github.com/jakevdp/PythonDataScienceHandbook>
- <https://www.kaggle.com>

### **III B. Tech. – II Semester (19BT70502) DATA SCIENCE**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

#### **PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Concepts of data science, Extracting meaning from data, The dimensionality problem, Plotting with pandas and seaborn, Probability distributions, Time series analysis, Predictive modeling.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on the concepts of data science to perform data analysis.
- CO2: Develop methods to extract meaning from data using feature selection techniques.
- CO3: Create data visualization using charts, plots and histograms to identify trends, patterns and outliers in data using Matplotlib and Seaborn.
- CO4: Develop distribution functions to analyze and interpret data to extract meaningful statistics.
- CO5: Design and develop predictive models for a given problem to support prediction and forecasting.

#### **DETAILED SYLLABUS:**

##### **UNIT-I: INTRODUCTION (09 Periods)**

Definition of data science, Skills for data science, Tools for data science, Data types, Data collections, Data preprocessing, Data analysis and data analytics, Descriptive analysis, Diagnostic analytics, Predictive analytics, Prescriptive analytics, Exploratory analysis, Mechanistic analysis.

##### **UNIT-II: DATA EXTRACTION (09 Periods)**

Extracting meaning from data – Feature selection, User retention, Filters, Wrappers, Entropy, Decision tree algorithm; Random forests, The dimensionality problem, Single value decomposition, Principal component analysis.

##### **UNIT-III: DATA VISUALIZATION (08 Periods)**

A Brief matplotlib API primer, Plotting with Pandas and Seaborn – Line plots, Bar plots, Histograms and density plots, Scatter plots, Facet grids and Categorical data; Other Python visualization tools.

##### **UNIT-IV: STATISTICAL THINKING (11 Periods)**

Distributions – Representing and plotting histograms, Outliers, Summarizing distributions, Variance, Reporting results; Probability mass function – Plotting PMFs, Other visualizations, The class size paradox, Data frame indexing; Cumulative distribution functions - Limits of PMFs, Representing CDFs, Percentile based statistics, Random numbers, Comparing percentile ranks; Modeling distributions - Exponential distribution, Normal distribution, Lognormal distribution.

## **UNIT-V: TIME SERIES ANALYSIS AND PREDICTIVE MODELING (08 Periods)**

Time series analysis – Importing and cleaning, Plotting, Moving averages, Missing values, Serial correlation, Autocorrelation; Predictive modeling – Overview, Evaluating predictive models, Building predictive model solutions, Sentiment analysis.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

### **TEXT BOOKS:**

1. Chirag Shah, *A Hands-on Introduction to Data Science*, Cambridge University Press, 2020.
2. Alen B. Downey, *Think Stats: Exploratory Data Analysis*, O'Reilly, 2<sup>nd</sup> Edition, 2014.

### **REFERENCE BOOKS:**

1. Wes McKinney, *Python for Data Analysis*, O'Reilly, 2<sup>nd</sup> Edition, 2017.
2. Ofer Mendelevitch, Casey Stella, Douglas Eadline, *Practical Data science with Hadoop and Spark: Designing and Building Effective Analytics at Scale*, Addison Wesley, 2017.
3. Rachel Schutt, Cathy O'Neil, *Doing Data Science: Straight Talk from the Frontline*, O'Reilly, 2014.
4. Jake VanderPlas, *Python Data Science Handbook: Essential Tools for Working with Data*, O'Reilly, 2017.

### **ADDITIONAL LEARNING RESOURCES:**

- [https://swayam.gov.in/nd1\\_noc19\\_cs60/preview](https://swayam.gov.in/nd1_noc19_cs60/preview)
- <https://towardsdatascience.com/>
- <https://www.w3schools.com/datascience/>
- <https://github.com/jakevdp/PythonDataScienceHandbook>
- <https://www.kaggle.com>

**III B. Tech. – II Semester**  
**(19BT60507) NATURE INSPIRED ALGORITHMS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on “Differential Equations and Multivariable Calculus”.

**COURSE DESCRIPTION:** Optimization, Classical optimization techniques, Nature inspired algorithms, Genetic algorithm, Particle swarm optimization, Ant colony optimization, Bee colony optimization, Cuckoo search algorithm, Firefly algorithm, Bat algorithm, Gray wolf optimization, Elephant herding optimization, Applications of nature inspired algorithms.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on optimization and classical optimization techniques to find optimal solutions for a given problem.
- CO2: Analyze the key components and mathematical aspects of nature inspired algorithms.
- CO3: Design efficient solutions for optimization problems using nature inspired algorithms.
- CO4: Investigate the applications of nature inspired algorithms to solve wide range of optimization problems.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO OPTIMIZATION (09 Periods)**

**Introduction to Optimization:** Fundamentals of optimization, Types of optimization problems, Examples of optimization, Formulation of optimization problems, Classification of optimization algorithms, Traveling salesman problem, Knapsack problem.

**Classical Optimization Techniques:** Mathematical model of optimization, Linear programming – Simplex method, Revised simplex method, Kamarkar’s method, Duality theorem, Decomposition principle, Transportation problem; Nonlinear Programming – Quadratic programming, Geometric programming; Dynamic programming, Integer programming, Stochastic programming, Lagrange multiplier method.

**UNIT-II: NATURE INSPIRED ALGORITHMS AND GENETIC ALGORITHM**

**(08 Periods)**

**Nature Inspired Algorithms:** Traditional vs nature inspired algorithms, Bioinspired algorithms, Swarm intelligence, Metaheuristics, Diversification and intensification, No free lunch theorem, Parameter tuning and control, Algorithm.

**Genetic Algorithm:** Basics, Genetic operators, Example of GA, Algorithm, Schema theory, Prisoner’s dilemma problem, Variants and hybrids of GA.



### **UNIT-III: PARTICLE SWARM, ANT COLONY, BEE COLONY AND CUCKOO SEARCH OPTIMIZATION ALGORITHMS (10 Periods)**

**Particle Swarm Optimization:** Swarm behavior, Algorithm, Variants of algorithm.

**Ant Colony Optimization:** Ant colony characteristics, Ant colony optimization – Travelling salesman problem, algorithm; Variants of algorithm.

**Bee Colony Optimization:** Honey bee characteristics, Algorithm, Variants of algorithm.

**Cuckoo Search Algorithm:** Cuckoo bird behavior, Levy flights, Algorithm, Variants of algorithm.

### **UNIT-IV: FIREFLY, BAT, GRAY WOLF AND ELEPHANT HERDING OPTIMIZATION ALGORITHMS (09 Periods)**

**Firefly Algorithm:** Firefly behavior and characteristics, Algorithm, Variants and applications.

**Bat Algorithm:** Behavior of bats in nature, Algorithm, Variants and applications.

**Gray Wolf Optimization:** Gray wolf characteristics, Gray wolf optimization, Variants and applications.

**Elephant Herding Optimization:** Elephant herding behavior, Algorithm, Pseudocode, Variants of the algorithm.

### **UNIT-V: APPLICATIONS OF NATURE INSPIRED ALGORITHMS (09 Periods)**

Image processing, Classification, clustering and feature selection, Traveling salesman problem, Vehicle routing, Scheduling, Software testing, Deep belief networks, Swarm robots, Data mining and deep learning – Clustering, Support vector machines, Artificial neural networks, Optimizers for machine learning, Deep learning.

**Total Periods: 45**

***Topics for self-study are provided in lesson plan***

#### **TEXT BOOKS:**

1. A. Vasuki, *Nature-Inspired Optimization Algorithms*, CRC Press, 2020.
2. Xin-She Yang, *Nature-Inspired Optimization Algorithms*, Elsevier, 2<sup>nd</sup> Edition, 2020.

#### **REFERENCE BOOKS:**

1. Xin-She Yang, Xing-Shi He, *Mathematical Foundations of Nature-Inspired Algorithms*, Springer, 2019.
2. George Lindfield, John Penny, *Introduction to Nature-Inspired Optimization*, Elsevier, 2017.

#### **ADDITIONAL LEARNING RESOURCES:**

- Xin-She Yang, *Nature-Inspired Computation and Swarm Intelligence: Algorithms, Theory and Applications*, Elsevier, 2020.
- Hema Banati, Shikha Mehta, Parmeet Kaur, *Nature-Inspired Algorithms for Big Data Frameworks*, IGI Global, 2019.

**III B. Tech. – II Semester**  
**(19BT60502) MACHINE LEARNING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Concept learning, General to specific ordering, Decision tree learning, Support vector machine, Artificial neural networks, Multilayer neural networks, Bayesian learning, Instance based learning, reinforcement learning.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the concept learning algorithms to automatically infer a general description for a given learning problem.
- CO2: Analyze the underlying mathematical models within machine learning algorithms and learning tasks.
- CO3: Evaluate and apply suitable machine learning algorithms for various types of learning tasks.
- CO4: Design efficient neural architectures to model patterns for a given learning problem.
- CO5: Select and apply machine learning algorithms to solve societal problems such as face recognition, text classification.

**DETAILED SYLLABUS:**

**UNIT-I: CONCEPT LEARNING AND GENERAL-TO-SPECIFIC ORDERING**

**(09 Periods)**

Well-posed learning problems, Designing a learning system, Perspectives and issues in machine learning, Concept learning task, Concept learning as search, FIND-S, Version spaces and candidate elimination algorithm, Inductive bias.

**UNIT-II: DECISION TREE LEARNING AND KERNEL MACHINES**

**(09 Periods)**

**Decision Tree Learning:** Decision tree representation, Problems for decision tree learning, Decision tree learning algorithm, Hypothesis space search, Inductive bias in decision tree learning, Issues in decision tree learning.

**Kernel Machines:** Support vector machines – SVMs for regression, SVMs for classification, Choosing C, A probabilistic interpretation of SVMs.

**UNIT-III: ARTIFICIAL NEURAL NETWORKS**

**(09 Periods)**

Neural network representations, Appropriate problems for neural network learning, Perceptrons, Multilayer networks and Backpropagation algorithm, Convergence and local minima, Representational power of feedforward networks, Hypothesis space search and inductive bias, Hidden layer representations, Generalization, Overfitting, Stopping criterion, An Example - Face Recognition.

**UNIT-IV: BAYESIAN LEARNING****(10 Periods)**

Bayes theorem and concept learning, Maximum likelihood and least-squared error hypothesis, Maximum likelihood hypotheses for predicting probabilities, Minimum Description Length principle, Bayes optimal classifier, Gibbs algorithm, Naive Bayes classifier, An Example – Learning to classify text; Bayesian belief networks, EM Algorithm.

**UNIT-V: INSTANCE BASED LEARNING AND REINFORCEMENT LEARNING****(08 Periods)**

**Instance Based Learning:** k-Nearest Neighbor learning, Locally weighted regression, Radial basis functions, Case-based reasoning.

**Reinforcement Learning:** The learning task, Q-learning, Nondeterministic rewards and actions, Temporal difference learning, Generalizing from examples, Relationship to dynamic programming.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. Tom M. Mitchell, *Machine Learning*, McGraw Hill, 2013.
2. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.

**REFERENCE BOOKS:**

1. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press, 4<sup>th</sup> Edition, 2020.
2. Shai Shalev Shwartz, Shai Ben David, *Understanding Machine Learning: From Theory to Algorithms*, Cambridge University Press, 2014.

**ADDITIONAL LEARNING RESOURCES:**

1. [https://swayam.gov.in/nd1\\_noc19\\_cs52/preview](https://swayam.gov.in/nd1_noc19_cs52/preview)
2. <https://www.udemy.com/course/machinelearning/>

**III B. Tech. – II Semester**  
**(19BT60531) MACHINE LEARNING LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** Courses on "Programming for Problem Solving", "Machine Learning"

**COURSE DESCRIPTION:** Implementation of Back propagation algorithm, Decision tree learning, Neural networks, k-NN from scratch algorithm, Naïve Bayes classifier, Radial basis function neural network, SVM based classifier, Maximum likelihood estimation using statistical techniques.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze the given problem and identify appropriate machine learning technique to provide an intelligent solution.
- CO2: Design and implement machine learning solutions for classification, regression, and clustering problems.
- CO3: Develop intelligent solutions to solve societal problems related to computer vision, information security, healthcare and other areas.
- CO4: Work independently to solve problems with effective communication.

**LIST OF EXERCISES:**

1. Solve classification problem by constructing a feedforward neural network using Backpropagation algorithm. (Wheat Seed Data)
2. Implement ID3 (information gain) algorithm for decision tree learning for transforming continuous variables into discrete variables.
3. Explore the problem of overfitting in decision tree and develop solution using pruning technique.
4. Build a neural network that will read the image of a digit and correctly identify the number.
5. Implement k-NN algorithm to solve classification problem.
6. Use Naïve Bayes classifier to solve the credit card fraud detection problem over a skewed dataset.
7. Design and implement a radial basis function neural network to solve function approximation or regression problem.
8. Compare and analyze the performance of optimal Bayes classifier and Naïve Bayes using simulated Gaussian Data.
9. Train an SVM based classifier to predict whether the cancer is malignant or benign.
10. Solve the stock price forecasting problem using statistical techniques – Maximum Likelihood estimation after understanding the distribution of the data.

**REFERENCE BOOKS:**

1. Sebastian Raschka, Vahid Mirjalili, *Python Machine Learning*, Packt Publishing, 3<sup>rd</sup> Edition, 2019.
2. Aurelien Geron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*, 2<sup>nd</sup> Edition, O'Reilly, 2019.

**SOFTWARE/TOOLS:**

- Python
- Scikit-learn/Keras/TensorFlow

**ADDITIONAL LEARNING RESOURCES:**

- <https://www.coursera.org/learn/machine-learning>
- <https://nptel.ac.in/courses/106106202/>

**IV B. Tech. – I Semester**  
**(19BT71503) DEEP LEARNING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on “Machine Learning”

**COURSE DESCRIPTION:** Overview of machine learning; Fundamentals of deep learning; Modern approaches in deep learning; Feedforward neural network architectures; Deep learning Models and Applications.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze a neural network by applying the basics of mathematics and machine learning.
- CO2: Analyze the data using multilayer perceptron and backpropagation algorithms.
- CO3: Apply regularization and optimization techniques to improve the performance of Deep neural networks.
- CO4: Identify appropriate deep learning model for text, multimedia, and biological data analysis.
- CO5: Compare deep neural networks and deep learning models to infer the suitable learning algorithm on large scale data.
- CO6: Develop a model for domain specific applications by applying various network models in deep learning.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION**

**(09 Periods)**

Historical Trends in Deep Learning – Machine Learning basics - Learning algorithms: Supervised and Unsupervised Training - Linear Algebra for Machine Learning - Testing - Cross Validation - Dimensionality Reduction - Over fitting /Under Fitting - Hyper parameters and validation sets - Estimators – Bias – Variance - Loss Function-Regularization.

**UNIT-II: NEURAL NETWORKS**

**(09 Periods)**

Biological Neuron – Idea of Computational units - Linear Perceptron - Perceptron Learning Algorithm - Convergence theorem for Perceptron Learning Algorithm - Linear Separability - Multilayer perceptron – Backpropagation.

**UNIT-III: MODERN PRACTICES IN DEEP NETWORKS**

**(10 Periods)**

Introductions to Simple DNN - Platform for Deep Learning - Deep Learning Software Libraries - Deep Feed forward networks – Gradient-Based Learning - Architecture Design –Various Activation Functions, ReLU, Sigmoid – Error Functions - Regularization methods for Deep Learning - Early Stopping - Drop Out - Optimization methods for Neural Networks-Adagrad, Adam.

**UNIT-IV: DEEP LEARNING MODELS****(09 Periods)**

Convolutional Neural Networks (CNNs): CNN Fundamentals – Architectures – Pooling – Visualization – Sequence Modeling: Recurrent Neural Networks (RNN) - Long-Short Term Memory (LSTM) – Bidirectional LSTMs-Bidirectional RNNs -Deep Unsupervised Learning: Autoencoders – Auto Encoder Applications -Deep Boltzmann Machine (DBM).

**UNIT-V: CASE STUDY AND APPLICATIONS****(08 Periods)**

Application Case Study - Handwritten digits recognition using deep learning - LSTM with Keras – Sentiment Analysis – Image Dimensionality Reduction using Encoders LSTM with Keras – Alexnet – VGGnet.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOK:**

1. Ian Goodfellow, Yoshua Bengio, Aaron Courville, *Deep Learning*, 4<sup>th</sup> Edition, MIT Press, 2016.

**REFERENCE BOOKS:**

1. Kevin P. Murphy, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
2. Michael A. Nielsen, *Neural Networks and Deep Learning*, Determination Press, 2015.
3. Deng & Yu, *Deep Learning: Methods and Applications*, Now Publishers, 2013.

**ADDITIONAL RESOURCES:**

1. [https://www.youtube.com/watch?reload=9&v=aPfkYu\\_qiF4](https://www.youtube.com/watch?reload=9&v=aPfkYu_qiF4)
2. <http://www.deeplearning.net/tutorial/>
3. <https://www.guru99.com/deep-learning-tutorial.html>
4. <https://www.coursera.org/courses?query=deep%20learning>

**IV B. Tech. – I Semester**  
**(19BT70533) DEEP LEARNING LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A Course on “Deep Learning”

**COURSE DESCRIPTION:** Implementation of deep learning architectures, Modern approaches in deep learning, Feedforward neural network architectures, Deep learning models and applications.

**COURSE OUTCOMES:** After successful completion of this course, the students will able to:

- CO1: Identify optimal hyperparameter values and appropriate architecture for a given problem and data using optimization techniques.
- CO2: Analyze the characteristics of the given data and perform necessary pre-processing tasks to structure the data using Python libraries.
- CO3: Utilize Python machine learning libraries and packages for building deep neural architectures to solve AI problems.
- CO4: Work independently to solve problems with effective communication.

**LIST OF EXERCISES:**

1. Perform splitting of data for training, testing, and validation using k-fold cross validation.
2. Construct and implement multi-layer feed forward neural network for hand written digit classification problem.
3. Implement a binary and multi class image classification using Convolution Neural Network.
4. Perform hyper parameter tuning using Bayesian optimization technique for a Convolution Neural Network.
5. Analyze the effectiveness of various optimization algorithms with an image classification problem.
6. Solve the overfitting problem in a neural architecture using DropOut technique.
7. Study the efficiency of the transfer learning approach for a classification problem on the following architectures; VGG-16, Alexnet, and Inception-V3.
8. Solve a seq2seq problem (machine translation) using LSTM Recurrent Neural Architecture.
9. Solve a time series forecasting (stock prediction) using LSTM RNN.
10. Implement the image dimensionality reduction problem using a AutoEncoder architecture.



**REFERENCE BOOKS:**

1. Ian Goodfellow, Yoshua Bengio and Aaron Courville, *Deep Learning*, MIT Press, 2016.
2. S Lovelyn Rose, L Ashok Kumar, D Karthika Renuka, *Deep Learning Using Python*, Wiley, 2019.
3. François Chollet, *Deep Learning with Python*, Manning Publications, 2017.
4. Jojo Moolayil, *Learn Keras for Deep Neural Networks: A Fast-Track Approach to Modern Deep Learning with Python*, Apress, 2018.

**SOFTWARE/TOOLS:**

- Environment: Google CoLab
- Programming Language: Python 3.8
- Machine Learning Library: Tensor Flow 2.1 and Keras

**ADDITIONAL LEARNING RESOURCES:**

- Bharath Ramsundar, Reza Bosagh Zadeh, *TensorFlow for Deep Learning*, O'reilly, 2018.
- <https://www.coursera.org/professional-certificates/tensorflow-in-practice>
- <https://www.coursera.org/learn/introduction-tensorflow>

## **MINOR DEGREE IN INTERNET OF THINGS**

**Offering Department:** INFORMATION TECHNOLOGY

**Students of Eligible Branches:** CSE, CSSE, ECE, EEE, EIE, ME and CE

### **COURSE STRUCTURE**

| Year & Semester                             | Course Code | Course Title                            | Contact Periods per week |   |   |       | C | Scheme of Examination<br>Max. Marks |            |             |
|---------------------------------------------|-------------|-----------------------------------------|--------------------------|---|---|-------|---|-------------------------------------|------------|-------------|
|                                             |             |                                         | L                        | T | P | Total |   | Int. Marks                          | Ext. Marks | Total Marks |
| III B.Tech.<br>I-Sem<br>(2 Theory + 1 Lab)  | 19BT51208   | Embedded System Design and Architecture | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                             | 19BT51209   | IoT Architecture and Protocols          | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                             | 19BT51210   | Sensor Technologies                     | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                             | 19BT51234   | Sensors based IoT Lab                   | -                        | - | 2 | 2     | 1 | 50                                  | 50         | 100         |
| III B.Tech.<br>II-Sem<br>(2 Theory + 1 Lab) | 19BT61207   | Cloud Storage and Computing             | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                             | 19BT61208   | Privacy and Security in IoT             | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                             | 19BT61209   | Software Defined Networks for IoT       | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                             | 19BT61233   | IoT Application Development Lab         | -                        | - | 2 | 2     | 1 | 50                                  | 50         | 100         |
| IV B.Tech.<br>I-Sem<br>(1 Theory + 1 Lab)   | 19BT71210   | Advanced IoT                            | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                             | 19BT71211   | Big Data Analytics for IoT              | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                             | 19BT71234   | Advanced IoT Lab                        | -                        | - | 2 | 2     | 1 | 50                                  | 50         | 100         |

**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

**III B. Tech. – I Semester**  
**(19BT51208) EMBEDDED SYSTEM DESIGN AND ARCHITECTURE**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Concepts of Embedded systems and its computing; The programming of 8051; The Embedded C and Applications; Applications of RTOS and Embedded Software Development Tools; The ARM and SHARC Processor's Architectures.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on Fundamental concepts of Embedded Systems in Real-time.
- CO2: Demonstrate programming skills using 8051.
- CO3: Develop the Embedded Systems applications.
- CO4: Demonstrate knowledge on RTOS concepts and Embedded Software Development Tools through RTOS.
- CO5: Demonstrate knowledge on advanced processors architecture such as ARM and SHARC and the bus protocols such as I2C and CAN bus.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO EMBEDDED COMPUTING (08 Periods)**

Definition of embedded system, embedded systems vs. general computing systems, history of embedded systems, complex systems and microprocessor, classification, major application areas, the embedded system design process, formalisms for system design, design examples

**UNIT-II: THE 8051 ARCHITECTURE (09 Periods)**

Introduction, 8051 Micro controller Hardware, Input/output Ports and Circuits, External Memory, Counter and Timers, Serial data Input/output, Interrupts. The Assembly Language Programming Process, Instructions of 8051 Programming Tools and Techniques, Simple Programs.

**UNIT-III: INTRODUCTION TO EMBEDDED C AND APPLICATIONS (10 Periods)**

Embedded systems programming in C, binding and running embedded C program in Keil IDE, dissecting the program, building the hardware. Basic techniques for reading and writing from I/O port pins, LED interfacing, interfacing with keyboards, displays, D/A and A/D conversions, using embedded C interfacing.

#### **UNIT-IV: INTRODUCTION TO REAL – TIME OPERATING SYSTEMS (10 Periods)**

Tasks and Task States, Semaphores, and Shared Data; Message Queues, Mailboxes and Pipes, Timer Functions, Events, Semaphores and Queues, Hard Real-Time Scheduling Considerations, Interrupt Routines in an RTOS Environment.

**EMBEDDED SOFTWARE DEVELOPMENT TOOLS:** Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine.

#### **UNIT-V: INTRODUCTION TO ADVANCED ARCHITECTURES (08 Periods)**

ARM and SHARC, Processor and memory organization and Instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus.

**Total Periods: 45**

*Topics for self-study are provided in lesson plan*

#### **TEXT BOOKS:**

1. Wayne Wolf, *Principles of Embedded Computing System Design*, Elsevier, 2<sup>nd</sup> Edition, 2014.
2. Kenneth J. Ayala, *The 8051 Microcontroller*, Thomson, 2<sup>nd</sup> Edition, 2016.

#### **REFERENCE BOOKS:**

1. David E. Simon, *An Embedded Software Primer*, Pearson Education, 2009.
2. Dr. KVKKPrasad, *Embedded/Real-Time Systems: Concepts, Design And Programming*, Black Book, DreamTech Press, 2003.

#### **ADDITIONAL LEARNING RESOURCES:**

##### **Web References:**

1. <https://www.smartzworld.com/notes/embedded-systems-es/>
2. <http://notes.specworld.in/embedded-systems-es/>
3. <http://education.uandistar.net/jntu-study-materials>
4. <http://www.nptelvideos.in/2012/11/embedded-systems.html>

##### **E-TextBooks:**

1. <https://www.scribd.com/doc/233633895/Intro-to-Embedded-Systems-by-Shibu-Kv>
2. [http://www.ee.eng.cmu.ac.th/~demo/think/\\_DXJSq9r3TvL.pdf](http://www.ee.eng.cmu.ac.th/~demo/think/_DXJSq9r3TvL.pdf)
3. <https://www.scribd.com/doc/55232437/Embedded-Systems-Raj-Kamal>
4. [https://docs.google.com/file/d/0B6CytI4eS\\_ahUS1LTkVXb1hxa00/edit](https://docs.google.com/file/d/0B6CytI4eS_ahUS1LTkVXb1hxa00/edit)

**III B. Tech. – I Semester**  
**(19BT51209) IoT ARCHITECTURE AND PROTOCOLS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** M2M to IoT An Architectural Overview and M2M and IoT Technology Fundamentals, IoT Architecture State of the Art, IoT Reference Architecture and Real-World Design Constraints, IoT Data Link Layer & Network Layer Protocols, Session Layer Protocols and Application Layer Protocols, Security in IoT Protocols and Case studies.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on architecture and technology of M2M to IoT.
- CO2: Demonstrate knowledge on IoT architectures and identify design constraints of IoT.
- CO3: Select suitable protocols of data link and network layer protocols for different applications of IoT.
- CO4: Identify appropriate protocols of session and application layer protocols for different applications of IoT.
- CO5: Evaluate security issues and challenges during implementation of real world models.

**DETAILED SYLLABUS:**

**UNIT-I: (09 Periods)**

**M2M TO IoT AN ARCHITECTURAL OVERVIEW:** Building architecture, Main design principles and needed capabilities, An IoT architecture outline, Standards considerations.

**M2M AND IoT TECHNOLOGY FUNDAMENTALS:** Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a service (XaaS), M2M and IoT analytics, Knowledge management.

**UNIT II: (09 Periods)**

**IoT ARCHITECTURE STATE OF THE ART:** Introduction, State of the art, Architecture Reference Model- Reference model and architecture, IoT reference model.

**IoT REFERENCE ARCHITECTURE:** Functional view, Functional view, Deployment and operational view, Other relevant architectural views

**REAL-WORLD DESIGN CONSTRAINTS:** Technical design constraints hardware is popular again, Data representation and visualization, Interaction and remote control

**UNIT III: (09 Periods)**

**IoT DATA LINK LAYER:** IEEE 802.15.4, IEEE 802.11ah, LoRaWAN, Z-Wave, Bluetooth Low Energy, Zigbee Smart Energy; **Network Layer Encapsulation Protocols:** 6LoWPAN, 6TiSCH, 6Lo;

**NETWORK LAYER ROUTING PROTOCOLS:**RPL, CORPL, CARP.

**UNIT IV:** (10 Periods)

**SESSION LAYER PROTOCOLS:** MQTT, AMQP, CoAP, XMPP, DDS;

**APPLICATION LAYER PROTOCOLS:** SCADA, Generic Web-Based Protocol.

**UNIT V:** (08 Periods)

**SECURITY IN IoT PROTOCOLS:**MAC 802.15.4, 6LoWPAN, RPL, IoT Challenges

**CASE STUDIES:** Smart Metering, Smart House, Smart Cities

**Total Periods: 45**

*Topics for self-study are provided in lesson plan*

**TEXT BOOKS:**

1. Jan Holler and Vlasios Tsiatsis, *From Machine-to-Machine to the Internet of Things Introduction to a New Age of Intelligence*, Elsevier, 2014.
2. David Hanes and Gonzalo Salgueiro, *IoT Fundamentals: Networking Technologies, Protocols, and Use Cases for the Internet of Things*, Cisco Press, 2017

**REFERENCE BOOKS:**

1. Peter Waher, *Learning Internet of Things*, PACKT publishing, 2015.
2. Olivier Hersent and David Boswarthick, *The Internet of Things Key Applications and Protocols*, John Wiley & Sons Ltd Publication, 2012.

**ADDITIONAL LEARNING RESOURCE:**

1. [http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot\\_prot/index.html](http://www.cse.wustl.edu/~jain/cse570-15/ftp/iot_prot/index.html)

**III B. Tech. – I Semester**  
**(19BT51210) SENSOR TECHNOLOGIES**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Physics.

**COURSE DESCRIPTION:** Sensor fundamentals and characteristics, Optical Sources and Detectors; Intensity Polarization and Interferometric Sensors, Phase sensor, Strain, Force, Torque and Pressure sensors; Position, Direction, Displacement and Level sensors, Velocity and Acceleration sensors, Electromagnetic velocity sensor, Light and Sound Sensors; Flow, Temperature and Acoustic sensors; Wearable Sensors.

**COURSE OUTCOMES:** After successful completion of this course, the student will be able to:

- CO1: Demonstrate knowledge on the characteristics of Sensors and principles of Optical Sources and Detectors.
- CO2: Apply the principles of Intensity Polarization, Interferometric, Phase, Strain, Force, Torque and Pressure sensors in Sensor applications.
- CO3: Apply the principles of Position, Direction, Displacement, Level, Velocity and Acceleration, Electromagnetic velocity, Sound and Light Sensors in Sensor applications.
- CO4: Analyze the principles of Flow, Temperature and Acoustic sensors to build Sensor applications.
- CO5: Analyze the principles of Wearable Sensors and identify suitable sensors for real time applications.

**DETAILED SYLLABUS:**

**UNIT-I: (09 Periods)**

**SENSOR FUNDAMENTALS AND CHARACTERISTICS:** Sensor Classification, Performance and Types, Error Analysis characteristics,

**OPTICAL SOURCES AND DETECTORS:** Electronic and Optical properties of semiconductor as sensors, LED, Semiconductor lasers, Fiber optic sensors, Thermal detectors, Photo multipliers, photoconductive detectors, Photo diodes, Avalanche photodiodes, CCDs.

**UNIT-II: (09 Periods)**

**INTENSITY POLARIZATION AND INTERFEROMETRIC SENSORS:** Intensity sensor, Microbending concept, Interferometers, Mach Zehnder, Michelson, FabryPerot and Sagnac.

**PHASE SENSOR:** Phase detection, Polarization maintaining fibers.

**STRAIN, FORCE, TORQUE AND PRESSURE SENSORS:** Strain gages, strain gage beam force sensor, piezoelectric force sensor, load cell, torque sensor, Piezo-resistive and capacitive pressure sensor, optoelectronic pressure sensors, vacuum sensors.

**UNIT-III:****(09 Periods)**

**POSITION, DIRECTION, DISPLACEMENT AND LEVEL SENSORS:** Potentiometric and capacitive sensors, Inductive and magnetic sensor, LVDT, RVDT, eddy current, transverse inductive, Hall effect, magneto resistive, magneto strictive sensors.

Fiber optic liquid level sensing, Fabry Perot sensor, ultrasonic sensor, capacitive liquid level sensor.

**VELOCITY AND ACCELERATION SENSORS:**

Electromagnetic velocity sensor, Doppler with sound, light, Accelerometer characteristics, capacitive, piezo-resistive, piezoelectric accelerometer, thermal accelerometer, rotor, monolithic and optical gyroscopes.

**UNIT-IV:****(09 Periods)**

**FLOW SENSORS:** pressure gradient technique, thermal transport, ultrasonic, electromagnetic and Laser anemometer. microflow sensor, coriolis mass flow and drag flow sensor.

**TEMPERATURE SENSORS:** thermoresistive, thermoelectric, semiconductor and optical. Piezoelectric temperature sensor.

**ACOUSTIC SENSORS:** microphones-resistive, capacitive, piezoelectric, fiber optic, solid state electret microphone.

**UNIT-V: WEARABLE SENSORS****(09 Periods)**

From fibers to textile sensors - Interlaced network -Textile sensors for physiological state monitoring - Biomechanical sensing - Noninvasive sweat monitoring by textile sensors and other applications. FBG sensor in Intelligent Clothing and Biomechanics.

**Total Periods: 45**

***Topics for self-study are provided in lesson plan***

**TEXT BOOKS:**

1. J. Fraden, *Handbook of Modern Sensors: Physical, Designs, and Applications*, AIP Press, 2004.
2. D. Patranabis, *Sensors and Transducers*, PHI Publication, 2<sup>nd</sup> Edition, 2014.

**REFERENCE BOOKS:**

1. Patranabis D, *Principles of Industrial Instrumentation*, Tata McGrawHill, End edition, 1997
2. Ganesh S. Hegde, *Mechatronics*, Published by University Science Press, 2008.



**III B. Tech. –I Semester**  
**(19BT51234) SENSOR BASED IoT LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Hands-on experience on connecting IoT devices using Sensors, Arduino/Raspberry Pi, Bread Board.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Identify different types of Sensors and study their functionality in IoT.
- CO2: Demonstrate skills in connecting peripherals to Arduino/Raspberry Pi for data exchange.
- CO3: Develop a Cloud platform to upload and analyze any sensor data.
- CO4: Demonstrate skills in connecting GSM, GPS, Gateways to micro controllers and perform Data Management in IoT.
- CO5: Build a complete working IoT system involving prototyping, programming and data analysis.
- CO6: Work independently or in teams to solve problems with effective communication.

**LIST OF EXPERIMENTS:**

1. Study of Different types of Sensors and Introduction to Arduino platform and programming.
2. Interfacing Arduino to Zigbee module.
3. Interfacing Arduino to GSM module and Bluetooth Module.
4. Introduction to Raspberry PI platform and python programming.
5. Interfacing sensors to Raspberry PI.
6. Communicate between Arduino and Raspberry PI using any wireless medium.
7. Log Data using Raspberry PI and upload to the cloud platform.
8. Design an IoT based system.

**REFERENCE BOOKS:**

1. Arshdeep Bahga, Vijay Madisetti, *Internet of Things- A hands on approach*, 1<sup>st</sup> edition, VPI publications, 2014.
2. Adrian McEwen, Hakin Cassimally, *Designing the Internet of Things*, Wiley India, 2013
3. Massimo Banzi and Michael Shiloh, *Getting Started with Arduino*, 3<sup>rd</sup> Edition, Maker Media, 2015
4. Getting Started with Raspberry pi, Matt Richardson & Shawn Wallace, O'Reilly, 2014.

### III B. Tech. – II Semester (19BT61207) CLOUD STORAGE AND COMPUTING

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

#### PRE-REQUISITES: --

**COURSE DESCRIPTION:** Introduction to Cloud Computing, Data Storage Networking fundamentals, Cloud Services and Platforms, Cloud Application Design.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate basic concepts and terminologies of Cloud Computing, Cloud-based Services and Applications.
- CO2: Demonstrate Cloud, Virtualization and Data Storage Networking concepts.
- CO3: Analyze Cloud Services, Platforms and Applications.
- CO4: Apply different Cloud Services and Platforms to construct Cloud applications.
- CO5: Design Cloud applications as per societal needs through different design approaches.

#### DETAILED SYLLABUS

##### UNIT-I: INTRODUCTION TO CLOUD COMPUTING (09 Periods)

Introduction, Characteristics of Cloud Computing. Cloud Models, Cloud Services Examples, Cloud-based Services and Applications.

##### UNIT-II: (09 Periods)

**CLOUD CONCEPTS AND TECHNOLOGIES:** Virtualization, Load Balancing, Scalability and Elasticity, Deployment, Replication, Monitoring, Software Defined Networking, Network Function Virtualization, MapReduce, Identity and Access Management, Service Level Agreements and Billing.

**DATA STORAGE FUNDAMENTALS:** Server and I/O Architectures, Storage Hierarchy, From Bits to Bytes, Disk Storage Fundamentals, Initiators and Targets, How Data Is Written to and Read from a Storage Device, Storage Sharing vs. Data Sharing, Different Types of Storage.

##### UNIT-III: CLOUD SERVICES AND PLATFORM -I (09 Periods)

Amazon Elastic Compute Cloud, Google Compute Engine, Windows Azure Virtual Machines, Amazon Simple Storage Service, Google Cloud Storage, Windows Azure Storage, Amazon Relational Data Store, Amazon DynamoDB, Google Cloud SQL, Google Cloud Datastore, Windows Azure SQL Database and Windows Azure Table Service.

##### UNIT-IV: CLOUD SERVICES AND PLATFORM -II (09 Periods)

Application Runtimes and Framework, Queuing Services, Email Services, Notification Services, Media Services, Amazon CloudFront, Windows Azure Content Delivery Network,

Amazon Elastic MapReduce, Google MapReduce Service, Google BigQuery, Amazon Elastic Beanstalk and Amazon CloudFormation.

#### **UNIT-V: CLOUD APPLICATION DESIGN**

**(09 Periods)**

Introduction, Design Considerations for Cloud Applications, Reference Architectures for Cloud Applications, Cloud Application Design Methodologies and Data Storage Approaches.

**Total Periods: 45**

***Topics for self-study are provided in lesson plan***

#### **TEXT BOOKS:**

1. ArshdeepBahga and Vijay Madiseti, *Cloud Computing – A Hands-on Approach*, Universities Press (India) Private Limited, 2014.
2. Greg Schulz, *Cloud and VirtualData Storage Networking*, CRC PressTaylor & Francis Group, 2012.

#### **REFERENCE BOOKS:**

1. Barrie Sosinsky, *Cloud Computing Bible*, Wiley India Pvt Ltd, 2011 (Reprint 2017).
2. Thomas Erl and RicardoPuttini, *Cloud Computing- Concepts, Technology and Architecture*, Pearson, 2014 (Seventh Impression 2017).

#### **ADDITIONAL LEARNING RESOURCES:**

1. "Exploring the Google Toolkit", <https://code.google.com/>, drafted on 21 June, 2021.
2. "Understanding Amazon Web Services", <https://aws.amazon.com/>, drafted on 21 June, 2021.

**III B. Tech. –II Semester**  
**(19BT61208) PRIVACY AND SECURITY IN IoT**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Internet of Things Lab.

**COURSE DESCRIPTION:** Introduction of IoT; Securing The Internet Of Things; Cryptographic Fundamentals for IoT; Identity & Access Management Solutions for IoT; Privacy Preservation And Trust Models for IoT; Cloud Security for IoT;

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate knowledge on Security issues of IoT.
- CO2. Apply Cryptographic Principles for IoT Security.
- CO3. Identify suitable Access Management Solutions for IoT.
- CO4. Apply Privacy Preservation and Trust Models for IoT.
- CO5. Demonstrate knowledge on Cloud Security for IoT.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION: SECURING THE INTERNET OF THINGS (09 Periods)**

Security Requirements in IoT Architecture, Security in Enabling Technologies, Security Concerns in IoT Applications; Security Architecture in the Internet of Things, Security Requirements in IoT, Insufficient Authentication/Authorization, Insecure Access Control, Threats to Access Control, Privacy, and Availability, Attacks Specific to IoT; Vulnerabilities, Secrecy and Secret-Key Capacity, Authentication/Authorization for Smart Devices; Transport Encryption; Attack & Fault trees

**UNIT-II: CRYPTOGRAPHIC FUNDAMENTALS FOR IoT (09 Periods)**

Cryptographic primitives and its role in IoT, Encryption and Decryption, Hashes, Digital Signatures, Random number generation, Cipher suites, key management fundamentals, cryptographic controls built into IoT messaging and communication protocols, IoT Node Authentication.

**UNIT-III: IDENTITY & ACCESS MANAGEMENT SOLUTIONS FOR IoT (09 Periods)**

Identity lifecycle, authentication credentials, IoT IAM infrastructure; Authorization with Publish/Subscribe schemes; access control.

**UNIT-IV: PRIVACY PRESERVATION AND TRUST MODELS FOR IoT (09 Periods)**

Concerns in data dissemination, Lightweight and robust schemes for Privacy protection, Trust and Trust models for IoT, self-organizing Things, Preventing unauthorized access

**UNIT-V: CLOUD SECURITY FOR IoT****(09 Periods)**

Cloud services and IoT - offerings related to IoT from cloud service providers, Cloud IoT security controls; An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing.

**Total Periods: 45*****Topics for self-study are provided in lesson plan*****TEXT BOOK:**

1. Brian Russell, Drew Van Duren, *Practical Internet of Things Security*, Kindle Edition, 2016.

**REFERENCE BOOK:**

1. Fei Hu, *Security and Privacy in Internet of Things (IoTs)- Models, Algorithms, and Implementations*, CRC Press, 1<sup>st</sup> Edition, 2016

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.fortinet.com/resources/cyberglossary/iot-security>

**III B. Tech. –II Semester**  
**(19BT61209) SOFTWARE DEFINED NETWORKS FOR IoT**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Internet of Things Lab.

**COURSE DESCRIPTION:** Packet Switching Terminology, Traditional Switch architecture, Fundamental Characteristics of SDN, SDN Controller, SDN Applications, SDN in the data center, Use Cases in the Data Center, Scope of the Internet of Things, SDN for IoT.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on characteristics of Data center and Network Technologies.
- CO2: Demonstrate skills on Operating and performing Data flow in Software Defined Networks.
- CO3: Identify suitable Data Center topologies for virtualized environment.
- CO4: Apply Software defined Networks concepts for the Internet of Things
- CO5: Apply suitable addressing schemes and routing protocols to achieve QoS in SDN based IoT.

**DETAILED SYLLABUS:**

**UNIT- I: INTRODUCTION TO SOFTWARE DEFINED NETWORKS (09 Periods)**

Basic Packet-Switching Terminology, The Modern Data Center, Traditional Switch architecture, Autonomous and Dynamic Forwarding Tables, Evolution of Switches and Control Planes ,SDN Implications for Research and Innovation, Data Center Innovation, Data Center Needs, The Evolution of Networking Technology, Forerunners of SDN, Software Defined Networking is Born, Sustaining SDN Interoperability, Open Source Contributions, Legacy Mechanisms Evolve Toward SDN, Network Virtualization.

**UNIT- II: FUNDAMENTAL CHARACTERISTICS OF SDN (09 Periods)**

SDN Operation, SDN Devices, SDN Controller, SDN Applications, Alternate SDN Methods, OpenFlow, OpenFlow Limitations, Potential Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays, SDN via Opening Up the Device, Network Functions Virtualization, Alternatives Overlap and Ranking. Real-World Data Center Implementations, applications and SDN features.

**UNIT-III: SDN IN THE DATA CENTER (09 Periods)**

Data Center Definition, Data Center Demands, Tunneling Technologies for the Data Center, Path Technologies in the Data Center, Ethernet Fabrics in the Data Center, SDN Use Cases in the Data Center, Open SDN versus Overlays in the Data Center.

**UNIT-IV: THE INTERNET OF THINGS****(09 Periods)**

Scope of the Internet of Things, Key Features of IoT Data, Technical requests for Openstack as a IoT-Cloud Platform, Feature of Message Broking, IoT architecture in NTT DATA, IoT architecture on Openstack, Endpoint-Aware Service Function Chaining, Service function chaining for the IoT data plane, Mobile Network Slicing for IoT, Introduction to IoTivity.

**UNIT- V: SDN for IoT:****(09 Periods)**

SDN based IoT, IoT Host Management System Architecture, Network Topology, Experiment Environment, Host Address collection, Host blocking, Host address translation, Dynamic QoS Routing Algorithm in SDN, SDN based Dynamic QoS Routing Framework, Mobility Support in SDN IoT networks, SDN and Cloud based Forest Fire Detection System using IoT devices.

**Total Periods: 45**

***Topics for self-study are provided in lesson plan***

**TEXT BOOKS:**

1. Paul Goransson and Chuck Balck, *Software Defined Networks -A comprehensive Approach*, 1<sup>st</sup> Edition, 2014.
2. Sunyoung Han, *Software Defined Network for Internet of Things*, Chulalongkorn University, Thailand, 2016.

**REFERENCE BOOKS:**

1. William Stallings, *Foundations of Modern Networking: SDN, NFV, QoE, IoT, and Cloud*, Addison-Wesley, 2015.
2. Jim Doherty, *SDN and NFV Simplified: A Visual Guide to Understanding Software Defined Networks and Network Function Virtualization*, Pearson, 2017.



**III B. Tech. –II Semester**  
**(19BT61233) IoT APPLICATION DEVELOPMENT LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A course on Internet of Things Lab.

**COURSE DESCRIPTION:** Hands-on practice on Internet of Things (IoT); Usage of Sensors, Arduino microcontroller and Raspberry Pi microprocessor; Development of IoT Applications for societal needs; IoT with Cloud environments.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Demonstrate hands-on experience on IoT.

CO2: Use Sensors, Arduino microcontroller and Raspberry Pi microprocessor for the development of IoT applications.

CO3: Analyze the user requirements for the development of IoT applications.

CO4: Develop IoT applications to solve societal problems using cloud environment.

CO5: Work independently or in teams to solve problems with effective communication.

**LIST OF EXPERIMENTS:**

1. Develop an IoT application to control servo motor using Arduino/Raspberry Pi.
2. Develop an IoT application using Arduino/Raspberry Pi for fire alarm.
3. Develop an IoT application to measure temperature, humidity, light and distance using Arduino/Raspberry Pi.
4. Develop an IoT application to control home appliances using a smart phone.
5. Develop an IoT application to measure soil moisture, air and water quality using Arduino/Raspberry Pi.
6. Develop an IoT application to control and monitor Street lights using Arduino/Raspberry Pi.
7. Develop an IoT application to detect obstacles using Arduino/Raspberry Pi.
8. Develop an IoT application using Arduino/Raspberry Pi to monitor heartbeat, blood pressure, etc. of a person and to upload health information to thingspeak cloud.
9. Develop an Alexa based Home Automation System using IoT.

**REFERENCE BOOKS:**

1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things( A hands on approach)*, 1<sup>st</sup> Edition, VPI Publications, 2014.
2. Adrian McEwen and Hakin Cassimally, *Designing the Internet of Things*, Wiley India.
3. Massimo Banzi and Michael Shiloh, *Getting Started with Arduino*, Third Edition, Maker Media.
4. Matt Richardson and Shawn Wallace, *Getting Started with Raspberry Pi*, O'Reilly, 2014.

**IV B. Tech. - I Semester**  
**(19BT71210) ADVANCED IoT**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Internet of Things Lab.

**COURSE DESCRIPTION:** Introduction to the Industrial Internet; Industrial Internet Use-Cases; Technical and Business Innovators of the Industrial Internet; IIoT Reference Architecture, Designing Industrial Internet Systems; Examining the Access Network Technology & Protocols; Examining the Middleware Transport Protocols; Middleware Software Patterns; Middleware Industrial Internet of Things Platforms; IIoT WAN Technologies and Protocols; Securing the Industrial Internet; Introducing Industry 4.0; Smart Factories.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Demonstrate knowledge on IIoT Concepts, applications, Technical requirements.

CO2: Design and develop IIoT applications, using different architectures and protocols.

CO3: Identify suitable middleware Transport Protocols, and Software Patterns to design APIs and Platforms.

CO4: Demonstrate knowledge on WAN Technologies & Protocols and security management in IIoT.

CO5: Demonstrate knowledge on Industry 4.0 and smart factories

**DETAILED SYLLABUS:**

**UNIT-I:**

**(09 Periods)**

**INTRODUCTION TO THE INDUSTRIAL INTERNET:** What is IIoT, Key IIoT Technologies Catalysts and Precursors of the IIoT, Innovation and the IIoT, Key Opportunities and Benefits, The Digital and Human Workforce.

**INDUSTRIAL INTERNET USE-CASES:** Healthcare, Oil and Gas Industry, Smart Office, Logistics and the Industrial Internet, Retail

**THE TECHNICAL AND BUSINESS INNOVATORS OF THE INDUSTRIAL INTERNET:** Miniaturization, Cyber Physical Systems (CPS), Wireless Technology, IP Mobility, Network Functionality Virtualization(NFV), Network Virtualization, The Cloud and Fog, Big Data and Analytics, M2M Learning and Artificial Intelligence, Augmented Reality, 3D Printing, People versus Automation

**UNIT-II:**

**(09 Periods)**

**IIoT REFERENCE ARCHITECTURE:** The IIC Industrial Internet Reference Architecture, Industrial Internet Architecture Framework (IIAF), Architectural Topology, The Three-Tier Topology, Connectivity, Key System Characteristics, Data Management.

**DESIGNING INDUSTRIAL INTERNET SYSTEMS:** The Concept of the IIoT, The Proximity Network, WSN Edge Node, Legacy Industrial Protocols, Modern Communication Protocols, Wireless Communication Technologies, Proximity Network Communication Protocols,

Gateways

**EXAMINING THE ACCESS NETWORK TECHNOLOGY AND PROTOCOLS:** The Access Network, Access Networks Connecting Remote Edge Networks

**UNIT-III:**

**(09 Periods)**

**EXAMINING THE MIDDLEWARE TRANSPORT PROTOCOLS:** TCP/IP, UDP, Reliable Transport Protocol (RTP), CoAP (Constrained Application Protocol).

**MIDDLEWARE SOFTWARE PATTERNS:** Publish/Subscribe Pattern: MQTT, XMPP, AMQP, DDS, Delay Tolerant Networks (DTN).

**SOFTWARE DESIGN CONCEPTS:** API (Application Programming Interface), API: A Technical Perspective, Web Services.

**MIDDLEWARE INDUSTRIAL INTERNET OF THINGS PLATFORMS:** Middleware Architecture, IIoT Middleware Platforms.

**UNIT-IV:**

**(09 Periods)**

**IIoT WAN TECHNOLOGIES AND PROTOCOLS:** IIoT Device Low-Power WAN Optimized Technologies for M2M, Low Power Wi-Fi, LTE Category-M, Weightless, Millimeter Radio.

**SECURING THE INDUSTRIAL INTERNET:** Security in Manufacturing: PLCs and DCS, Securing the OT, Network Level: Potential Security Issues, System Level: Potential Security Issues, Identity Access Management

**UNIT-V:**

**(09 Periods)**

**INTRODUCING INDUSTRY 4.0:** Defining Industry 4.0, Four Main Characteristics of Industry 4.0, The Value Chain, Industry 4.0 Design Principles, Building Blocks of Industry 4.0, Smart Manufacturing.

**SMART FACTORIES:** Introducing the Smart Factory, Smart Factories in Action, Importance of Smart Manufacturing, Real-World Smart Factories - GE's Brilliant Factory, Airbus: Smart Tools and Smart Apps, Siemens' Amberg Electronics Plant (EWA), Industry 4.0: The Way Forward

**Total Periods: 45**

***Topics for self-study are provided in lesson plan***

**TEXT BOOK:**

1. Alasdair Gilchrist, *Industry 4.0: The Industrial Internet of Things*, Apress Publications, 2016.

**REFERENCE BOOKS:**

1. Giacomo Veneri and Antonio Capasso, *Hands-on Industrial Internet of Things: Create a powerful Industrial IoT infrastructure using Industry 4.0*, Ingram Academic Services, 2018.
2. Vijay Madisetti and Arshdeep Bahga, *Internet of Things A Hands-On- Approach*, Orient Blackswan Private Limited, 2015.
3. Francis daCosta, *Rethinking the Internet of Things: A Scalable Approach to Connecting Everything*, 1<sup>st</sup> edition, Apress Publications, 2014.

**IV B. Tech. - I Semester**  
**(19BT71210)BIG DATA ANALYTICS FOR IoT**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | 1 | - | 4 |

**PRE-REQUISITES:** A course on Internet of Things Lab.

**COURSE DESCRIPTION:** The course provides introduction to IoT Analytics and Big Data Analytics, Sensors And Tools of IoT Analytics, Services of IoT, Big Data Storage Systems for IoT, Case Studies and Applications of IoT

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Use Analytical Architecture and its exploration in Data Analytics for IoT
- CO2: Analyze and Visualize the Sensor data for IoT.
- CO3: Apply Advanced Analytical Architectures as a service for IoT.
- CO4: Analyze Big data storage systems in IoT.
- CO5: Develop Real Time solutions for given societal problems.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCING IoT ANALYTICS (09 Periods)**

**Introduction:**IoT Data and BigData,Challenges of IoT Analytics Applications,IoT Analytics Lifecycle and Techniques.**IoT, Cloud and Big Data Integration for IoT Analytics:**Cloud-based IoT Platform,Data Analytics for the IoT,Data Collection Using Low-power, Long-range Radios,WAZIUP Software Platform, iKaaS Software Platform.

**UNIT-II: SENSORS AND TOOLS OF IoT ANALYTICS (09 Periods)**

**Sensors:** Architecture for Social and Physical Sensors, Local Event Retrieval, Using Sensor Metadata Streams to Identify Topics of Local Events in the City, Venue Recommendation. **Development Tools for IoT Analytics Applications:**VITAL Development Environment,Tools for IoT Semantic Analytics, Development Examples:Predict the Footfall!,Find a Bike!

**UNIT-III: IoT ANALYTICS AS A SERVICE (09 Periods)**

Architecture for IoT Analytics-as-a-Service, Sensing-as-a-Service Infrastructure Anatomy, Scheduling, Metering and Service Delivery, Sensing-as-a-Service Examples, From Sensing-as-a-Service to IoT-Analytics-as-a-Service, Data Collection to Deployment and Operationalization, Ethical IoT.

#### UNIT-IV: BIG DATA STORAGE SYSTEMS AND CASE STUDIES FOR IoT

(09 Periods)

**Perspectives and Challenges:** Big data analytics for IoT, Data Storage and Access for IoT, Dynamic-Data Handling in Big Data Storage Systems, Heterogeneous Datasets in IoT Big Data, Semantic Analytics for Big Data. **Case Studies:** Data Analytics in Smart Buildings, Internet-of-Things Analytics for Smart Cities.

#### UNIT-V: APPLICATIONS OF IoT AND BIG DATA SOLUTIONS

(09 Periods)

**IoTBDs Applications:** Smart Transportation, Smart Healthcare, Smart Grid, Smart Inventory System, Smart Manufacturing, Smart Retail, Smart agriculture, **Big Data Management Solutions for IoT:** Case Study – Connected Car.

**Total Periods: 45**

*Topics for self-study are provided in lesson plan*

#### TEXT BOOKS:

1. John Soldatos, *Building Blocks for IoT Analytics*, River Publishers, 2017.
2. Pethuru Raj, T. Poongodi, Balamurugan Balusamy, and Manju Khari, *Internet of Things and Big Data Analytics Integrated Platforms and Industry Use Cases*, 1<sup>st</sup> edition, CRC Press, 2020.

#### REFERENCE BOOKS:

1. Hwaiyu Geng, P.E., *Internet of Things and Data Analytics Handbook*, Wiley Publishing, 2017.
2. Dey. N, Hassanien A.E, Bhatt C, Ashour A.S, Satapathy S.C, *Data Analytics: Internet of Things and Big Data Analytics Toward Next-Generation Intelligence*, Springer, 2018.

#### ADDITIONAL LEARNING RESOURCES:

1. [https://www.tutorialspoint.com/excel\\_data\\_analysis/data\\_analysis\\_overview.html](https://www.tutorialspoint.com/excel_data_analysis/data_analysis_overview.html)
2. <https://data-flair.training/blogs/data-analytics-tutorial/>
3. <https://pythonprogramming.net/data-analysis-tutorials/>

**IV B. Tech. –I Semester**  
**(19BT71234) ADVANCED IoT LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A course on Internet of Things Lab.

**COURSE DESCRIPTION:** Hands-on practice on Internet of Things (IoT); IBM Bluemix; Amazon AWS cloud; Google Firebase; Git hub IoT packages; Python IoT libraries for the development of IoT applications.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate hands-on experience on IoT.
- CO2: Use IBM Bluemix, Amazon AWS cloud, Google Firebase, Git hub IoT packages and Python libraries for the development of IoT applications.
- CO3: Analyze the user requirements for the development of IoT applications.
- CO4: Develop IoT applications to solve societal problems using cloud environment.
- CO5: Work independently or in teams to solve problems with effective communication.

**LIST OF EXPERIMENTS:**

1. Study of AT89S52 Ultra Development Kit with Development Tool /Environment of Kiel Software for Microcontroller programming
2. Familiarize with Intel Galileo Gen2 board and understand the procedure of creation and compilation of C source code.
3. Study of IoT Data Logging using Beaglebone Black and Thingspeak.
4. Turn your smartphone into an IoT device using the IBM Watson IoT Platform cloud-hosted service.
5. Controlling home light using WiFi Node MCU, and Relay module
6. Develop an application using the Google Firebase NodeMCU ESP8266
  - a) Connecting Arduino Node-MCU with Google Firebase
  - b) Control Led Using Firebase Console
  - c) Control Led with Android App using Firebase database
7. Develop an application using the Google Firebase for controlling LED and Android App with NodeMCU
8. Configuring IOT Based DHT Sensor using AWS
9. Design and develop Alexa based Home Automation System using AWS.

**REFERENCE BOOKS:**

1. Arshdeep Bahga and Vijay Madisetti, *Internet of Things( A hands on approach)*, 1<sup>st</sup> Edition, VPI Publications, 2014.
2. Adrian McEwen and Hakin Cassimally, *Designing the Internet of Things*, Wiley India.
3. Massimo Banzi and Michael Shiloh, *Getting Started with Arduino*, 3<sup>rd</sup> Edition, Maker Media.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://aws.amazon.com/iot-core/getting-started/>
2. <https://www.balena.io/docs/learn/develop/integrations/bluemix/>
3. <https://github.com/thingsboard>
4. <https://www.javatpoint.com/iot-internet-of-things>



## **MINOR DEGREE IN CYBER SECURITY**

**Offering Department:** COMPUTER SCIENCE AND SYSTEMS ENGINEERING  
**Students of Eligible Branches:** ECE, EEE, EIE, ME and CE

### **COURSE STRUCTURE**

| Year & Semester                                 | Course Code | Course Title                       | Contact Periods per week |   |   |       | C | Scheme of Examination<br>Max. Marks |            |             |
|-------------------------------------------------|-------------|------------------------------------|--------------------------|---|---|-------|---|-------------------------------------|------------|-------------|
|                                                 |             |                                    | L                        | T | P | Total |   | Int. Marks                          | Ext. Marks | Total Marks |
| III B.Tech.<br>I-Sem<br><br>(2 Theory + 1 Lab)  | 19BT40501   | Computer Networks                  | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                                 | 19BT60541   | Adhoc and wireless Sensor Networks | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                                 | 19BT31502   | Operating Systems                  | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                                 | 19BT40531   | Computer Networks Lab              | -                        | - | 2 | 2     | 1 | 50                                  | 50         | 100         |
| III B.Tech.<br>II-Sem<br><br>(2 Theory + 1 Lab) | 19BT61201   | Cloud Computing                    | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                                 | 19BT51501   | Modern Cryptography                | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                                 | 19BT50503   | Cyber security                     | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                                 | 19BT61534   | Modern Cryptography Lab            | -                        | - | 2 | 2     | 1 | 50                                  | 50         | 100         |
| IV B.Tech.<br>I-Sem<br><br>(1 Theory + 1 Lab)   | 19BT61509   | IoT Security                       | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                                 | 19BT61502   | Information Security               | 3                        | - | - | 3     | 3 | 40                                  | 60         | 100         |
|                                                 | 19BT71534   | Information Security Lab           | -                        | - | 2 | 2     | 1 | 50                                  | 50         | 100         |

**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

**III B. Tech. - I Semester**  
**(19BT40501) COMPUTER NETWORKS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to computer networks; Protocols of physical layer, data link layer, medium access control sub layer, network layer, transport layer, application layer.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Analyze the types of network topologies, layers and protocols.
- CO2. Evaluate subnetting and routing algorithms for finding optimal paths in networks.
- CO3. Solve problems related to flow control, error control and congestion control in data transmission.
- CO4. Assess the impact of wired and wireless networks in the context of network protocols Like DNS, SMTP, HTTP, and FTP.
- CO5. Apply ethical principles and standards for developing network-based solutions.

**DETAILED SYLLABUS:**

**UNIT- I: INTRODUCTION AND PHYSICAL LAYER (09 Periods)**

Network hardware, Network software, Reference models - OSI, TCP/IP; Example networks - Internet; Wireless LANs - 802.11.

**Physical Layer** - Guided transmission media, Wireless transmission, Switching - Circuit switching, Packet switching.

**UNIT- II: DATA LINK LAYER AND MEDIUM ACCESS CONTROL SUBLAYER (09 Periods)**

**Data Link Layer:** Data link layer design issues, Error detection and correction - CRC, Hamming codes; Elementary data link protocols, Sliding window protocols.

**Medium Access Control Sub layer:** ALOHA, Carrier sense multiple access protocols, Collision free protocols, Ethernet, Data link layer switching - Repeaters, Hubs, Bridges, Switches, Routers, Gateways.

**UNIT- III: NETWORK LAYER (09 Periods)**

Network layer design issues, Routing algorithms - Shortest path algorithm, Flooding, Distance vector routing, Link state routing, Hierarchical routing, Broadcast routing, Multicast routing, Anycast routing; Congestion control algorithms, Network layer in the internet - The IP version 4 protocol, IP addresses, IP version 6, Internet control protocols, OSPF, BGP.

**UNIT- IV: TRANSPORT LAYER****(09 Periods)**

UDP – Segment header, Remote procedure call, Real-time transport protocols; TCP – service model, Protocol, Segment header, Connection establishment, Connection release, Sliding window, Timer management, Congestion control.

**UNIT- V: APPLICATION LAYER****(09 Periods)**

Domain Name System (DNS) - Name space, Domain resource records, Name servers; Electronic mail - Architecture and services, User agent, Message formats, Message transfer, Final delivery; The World Wide Web - Architectural overview, HTTP, FTP.

**Total Periods: 45*****Topics for self-study are provided in the lesson plan*****TEXT BOOK:**

1. Andrew S. Tanenbaum and David J. Wetherall, *Computer Networks*, Pearson, 5<sup>th</sup> Edition, 2015.

**REFERENCE BOOKS:**

1. Behrouz A. Forouzan, *Data Communications and Networking*, McGraw Hill, 5<sup>th</sup> Edition, 2013.
2. James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach*, Pearson, 7<sup>th</sup> Edition, 2017.

**ADDITIONAL LEARNING RESOURCES:**

- <https://www.cisco.com/c/en/us/solutions/small-business/resourcecenter/networking/networking-basics.html>
- <https://memberfiles.freewebs.com/00/88/103568800/documents/Data.And.Computer.Communications.8e.WilliamStallings.pdf>

**III B. Tech. – I Semester**  
**(19BT60541) ADHOC AND WIRELESS SENSOR NETWORKS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Ad hoc Wireless Networks, Medium Access Control Protocols for Ad hoc Wireless Networks, Routing Protocols for Ad hoc Wireless Networks, Wireless Sensor Networks, Medium Access Control Protocols for WSN's.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Investigate ad hoc and wireless sensor networks to improve the network performance.
- CO2: Analyze the issues in MAC, routing protocols in Ad hoc wireless networks.
- CO3: Apply routing protocols of MAC Layer in sensor networks to provide networking solutions.
- CO4: Follow norms and standards in engineering practice to solve ad hoc and wireless sensor network problems.

**DETAILED SYLLABUS:**

**UNIT-I: AD HOC WIRELESS NETWORKS (08 Periods)**

Fundamentals of wireless communication technology, the electromagnetic spectrum, Radio propagation mechanisms, Characteristics of the wireless channel, Applications, Issues, Ad hoc wireless Internet.

**UNIT-II: MAC PROTOCOLS FOR AD HOC WIRELESS NETWORKS (08 Periods)**

Issues in designing a MAC protocol, Classification of MAC protocols, Contention based protocols, Contention based protocols with reservation mechanisms, and Contention based protocols with scheduling mechanisms.

**UNIT-III: ROUTING PROTOCOLS FOR AD HOC WIRELESS NETWORKS (09 Periods)**

Issues in designing routing and transport layer protocol for Ad hoc networks, Classification of routing protocols, Table driven routing protocols, On demand routing protocols, Hybrid routing protocols.

**UNIT-IV: WIRELESS SENSOR NETWORKS (09 Periods)**

Vision of ambient intelligence, Application examples, Types of applications, Challenges of WSN's, Why are sensor networks different, Enabling technologies, Hardware components, Energy consumption of sensor nodes.

## **UNIT-V: MEDIUM ACCESS CONTROL PROTOCOLS FOR WIRELESS SENSOR NETWORKS (11 Periods)**

Fundamentals of MAC protocols, Low duty cycle protocols and wake up concepts, Contention based protocols, Schedule based protocols, IEEE 802.15.4 MAC protocol, 802.11 and Bluetooth, Case study on tele healthcare – Introduction, MASN hardware design, Reliable MASN communication protocols, MASN software design, Integration of RFID and wearable sensors.

**Total Periods: 45**

***Topics for self-study are provided in lesson plan***

### **TEXT BOOKS:**

1. C. Siva Ram Murthy, B.S. Manoj, *Ad Hoc Wireless Networks: Architectures and Protocols*, Pearson, 2012.
2. Holger Karl and Andreas Willig, *Protocols and Architectures for Wireless Sensor Networks*, Wiley, 2017.

### **REFERENCE BOOKS:**

1. Fei Hu and Xiaojun Cao, *Wireless Sensor Networks: Principles and Practice*, CRC Press, 2010.
2. Yi Qian, Peter Muller and Hsiao-Hwa Chen, *Security in Wireless Networks and Systems*, Wiley, 2011.

### **ADDITIONAL LEARNING RESOURCES:**

- <https://www.tyndall.ie/wireless-sensor-networks-2>
- <https://www.elprocus.com/introduction-to-wireless-sensor-networks-types-and-applications/>
- <https://www.analog.com/en/design-center/landing-pages/002/apm/wsn-solution-2014.html>

**II B. Tech. – I Semester**  
**(19BT31502) OPERATING SYSTEMS**

|            |            |             |   |   |   |   |
|------------|------------|-------------|---|---|---|---|
| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Operating Systems Operations; Process Scheduling; Process Synchronization, Deadlocks; Paging and Segmentation, Disk Scheduling; File Concepts, I/O Interface; Concepts of Protection and Security.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze performance of CPU scheduling algorithms.
- CO2: Design solutions for process synchronization problems by using semaphores and monitors.
- CO3: Devise solutions for deadlocks using deadlock handling mechanisms.
- CO4: Solve memory management problems using page replacement and disk scheduling algorithms.
- CO5: Identify efficient file allocation methods for optimal disk utilization.
- CO6: Analyze services of I/O subsystems and mechanisms of security & protection.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO OPERATING SYSTEM AND PROCESS MANAGEMENT (08 Periods)**

**INTRODUCTION:** Definition, Operating System Structure and Services, System Calls.

**PROCESS MANAGEMENT:** Process Scheduling, Process Control Block, Inter Process Communication, Threads, Multithreading Models, CPU Scheduling Criteria, Scheduling Algorithms, Multiprocessor Scheduling.

**UNIT-II: PROCESS SYNCHRONIZATION AND DEADLOCKS (10 Periods)**

**PROCESS SYNCHRONIZATION:** Critical Section Problem, Peterson's Solution, Synchronization Hardware, Semaphores, Synchronization Problems, Monitors.

**DEADLOCKS:** System Model, Deadlock characterization, Methods for handling deadlocks, Prevention, Detection, Avoidance, Recovery from deadlock.

**UNIT-III: MEMORY MANAGEMENT AND SECONDARY STORAGE (10 Periods)**

**MEMORY MANAGEMENT:** Swapping, Contiguous Allocation, Paging, Segmentation, Segmentation with Paging.

**VIRTUAL MEMORY:** Demand Paging, Page Replacement Algorithms, Copy-on-Write, Thrashing.

**SECONDARY STORAGE STRUCTURE:** Overview of Mass Storage Structure, Disk Structure, Disk Scheduling, Disk Management.

**UNIT-IV: File and I/O Systems****(08 Periods)**

**FILE SYSTEM:** File concept, Access Methods, Directory Structure, File System Structure, i-node, File System Implementation, Directory Implementation, Allocation Methods.

**I/O SYSTEM:** I/O Hardware, Application I/O Interface, Kernel I/O subsystem.

**UNIT-V : PROTECTION AND SECURITY****(09 Periods)**

**PROTECTION:** Goals, Principles, Domain of Protection, Access Matrix, Implementation of Access Matrix, Access Control, Revocation of Access Rights.

**SECURITY:** Security Problem, Program Threats, System and Network Threats, User Authentication, Implementing Security Defenses, Firewalling to Protect Systems and Networks, Computer-Security Classifications.

**Total Periods: 45**

***Topics for Self Study are provided in Lesson Plan***

**TEXT BOOK:**

1. Abraham Silberschatz, Peter Baer Galvin and Greg Gagne, *Operating System Concepts*, Wiley India Edition, 9<sup>th</sup> Edition, 2016.

**REFERENCE BOOKS:**

1. William Stallings, *Operating Systems, Internals and Design Principles*, Pearson Education, 7<sup>th</sup> Edition, 2013.
2. Andrew S. Tanenbaum, *Modern Operating Systems*, PHI, 3<sup>rd</sup> Edition, 2009.

**III B. Tech. - I Semester**  
**(19BT40531) COMPUTER NETWORKS LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** - A Course on Computer Networks.

**COURSE DESCRIPTION:** Hands on practice with NS3; Packet Tracer network simulation tools; Simulation of network topologies; ARP protocol; CSMA/CD protocol; Distance Vector/Link State Routing protocols; Transmission errors; Sliding window protocol; TCP; UDP.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply mathematical foundations to solve computational problems in computer networks.
- CO2: Select and apply network simulation tools like NS3, Packet Tracer to simulate networking protocols.
- CO3: Simulate and analyze network topologies, network protocols to provide efficient networking solutions.
- CO4: Work independently and communicate effectively in oral and written forms.

**LIST OF EXERCISES:**

1. a) Study of network devices and network IP in detail.  
b) Simulate a peer to peer topology of a computer network.  
c) Simulate IPv4 addressing in a computer network (give IP Address of different classes in given Network id).

Exercises on Packet Tracer Simulator Tool:

2. Introduction to Packet Tracer
3. a) Study of basic network commands and network configuration commands.  
i) ping ii) nslookup iii) netstat iv) ifconfig  
b) Create a network topology and configure a network topology with four PCs, two switches, and two routers.

Exercises on NS3 Simulator Tool:

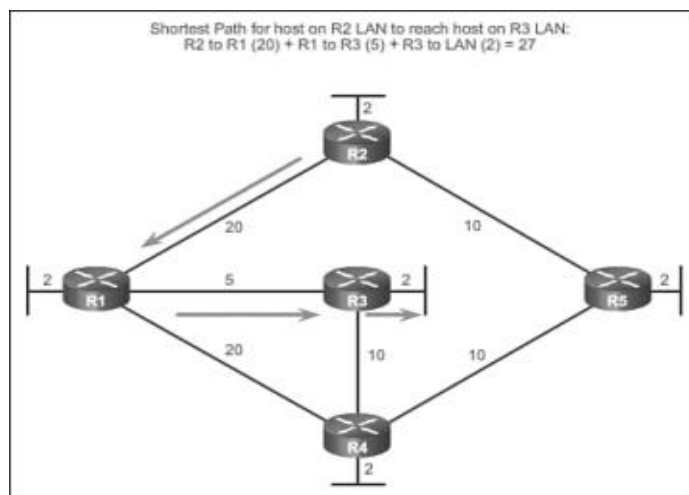
4. a) Introduction to NS3 tool.  
b) Create a network with three nodes namely 0, 1 and 2. Establish a TCP connection between node 0 and node 2 such that node 0 will send TCP packets to node 2 via node 1.
5. a) Create a simple topology of two nodes (Node1, Node2) separated by a point-to-point link. Setup a UDP Client on one Node1 and a UDP Server on Node2. Consider a fixed data rate Rate1.  
i) Measure end to end throughput whilst varying the latency of the link.  
ii) Add another client application to Node1 and a server instance to Node2. What do you need to configure to ensure that there is no conflict?  
iii) Repeat step 3 with the extra client and server application instances. Show screenshots of pcap traces which indicate that delivery is made to the appropriate server instance.  
b) Simulate a Local Area Network. Consider a local area network formed by nodes



- 3, 4, and 5. This LAN communicates with the external world through a router denoted by node 2. There are two servers connected to the router and represented by nodes 0 and 1. Node 0 is running an application over TCP, which is accessed by node 4. Node 1 is running an application on UDP, which is accessed by node 5. Analyze the trace file.
6. Simulate link errors. Presence of link errors cause one or more packets to be retransmitted. Consider the following topology.



- Node #2 act as a router. Any traffic to or from the LAN passes through it. Consider node #1 running a FTP server, and node #5 is downloading a file of size 4 MB. However, the link between node #2 and #3 is fault. It drops packets with a fixed probability of 0.2. Implement a link error model to reflect this. Try different values of the simulation time to ensure that the file has been entirely transferred. Has the plot of bytes received a linear curve or non-linear? Why?
7. Simulate Address Resolution Protocol (ARP) to associate a logical address with a physical address and Reverse Address Resolution Protocol (RARP) allows a host to discover its Internet address when it knows only its physical address.
8. Simulate packet transmission over a CSMA/CD based LAN with NS3. Consider the LAN with seven nodes to be an isolated one i.e. not connected to the Internet. Node #0 in the LAN acts as a UDP traffic source, and node #6 is the destination node. Assume CBR traffic to be flowing between the nodes. The simulation lasts for 25 seconds. In Ethernet a packet is broadcasted in the shared medium, and only the destination node accepts the packet. Other nodes simply drop it. What should be the number of hops a packet from node #0 to node # 6 travel? Verify this from the "Hop Count" plot.
9. a) UDP uses a simple connectionless communication model with a minimum of protocol mechanism. The implementation provides checksums for data integrity, and port numbers for addressing different functions at the source and destination of the datagram. Simulate half duplex chat User Datagram Protocol.
- b) TCP model supports a full bidirectional TCP with connection setup and close logic. Simulate full duplex chat Transmission Control Protocol.
- 10 a) In a typical FTP session, the user is sitting in front of one host (the local host) and wants to transfer files to or from a remote host. Implement File Transfer Protocol to move files between local and remote file systems.
- b) Sliding window protocol supports reliable and efficient transmission between nodes and it also obtains higher throughput than that of stop-n-wait protocol. Simulate sliding window protocol normal operation and timeout operations.
- 11 Configure the following network to find shortest path between R2 LAN to R3 LAN using Distance Vector / Link State Routing Protocol.



### REFERENCE BOOKS:

1. Andrew S. Tanenbaum and David J. Wetherall, *Computer Networks*, Pearson, 5<sup>th</sup> Edition, 2015.
2. A. Jesin, *Packet Tracer Network Simulator*, Packt Publishing, 2014.
3. Jack L. Burbank, *An Introduction to Network Simulator 3*, Wiley, 2018.

### Software/Tools used:

- Network simulator tools - NS3, Packet Tracer
- Virtual Labs (Computer Networks Lab – [http://vlabs.iitb.ac.in/vlabs-dev/labs\\_local/computer-networks/labs/explist.php](http://vlabs.iitb.ac.in/vlabs-dev/labs_local/computer-networks/labs/explist.php))
- Virtual Labs (Advanced Network Technologies Virtual Lab – <http://vlabs.iitkgp.ernet.in/ant>)

**III B. Tech. – II Semester**  
**(19BT61201) CLOUD COMPUTING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Fundamental Cloud Computing and Virtualization; Understanding Cloud Models and Architectures; Understanding Cloud Services, Applications and Capacity Planning; Exploring Platform as a Service (PaaS); Exploring Infrastructure as a Service (IaaS).

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate knowledge on basic concepts and terminologies of Cloud Computing and Virtualization.
- CO2. Select appropriate Cloud deployment models, Service models and Architectures in Cloud Application development.
- CO3. Analyze Cloud services, Applications and Capacity Planning.
- CO4. Apply different PaaS application frameworks to construct Cloud applications.
- CO5. Develop web applications through Google, Microsoft and Amazon web services as per societal needs.

**DETAILED SYLLABUS:**

**UNIT-I: FUNDAMENTAL CLOUD COMPUTING AND VIRTUALIZATION (10 Periods)**

**Cloud Computing:** Origin and influences, Basic concepts and terminology, Goals and benefits, Risks and challenges, Roles and boundaries and Cloud characteristics.

**Introduction to Virtualization:** Characteristics, Taxonomy of virtualization technologies, Pros and cons of virtualization, Virtualization Technologies: Xen, VMware and Hyper-V.

**UNIT-II: UNDERSTANDING CLOUD MODELS AND ARCHITECTURES (08 Periods)**

**Cloud Models:** NIST model, Cloud Cube model, Deployment models: Public, Private, Hybrid and Community; Service models: IaaS, PaaS and SaaS.

**Understanding Cloud Architecture:** Exploring the Cloud Computing Stack: Composability, Infrastructure, Platforms, Virtual Appliances, Communication Protocols, Applications; Connecting to the Cloud: The Jolicloud Netbook OS and Chromium OS - The Browser as an Operating System.

**UNIT-III: UNDERSTANDING CLOUD SERVICES, APPLICATIONS AND CAPACITY PLANNING (09 Periods)**

**Understanding Cloud Services and Applications** Infrastructure as a Service (IaaS): IaaS workloads, Pods, aggregation, and silos; Platform as a Service (PaaS), Software as a Service (SaaS): SaaS characteristics, Open SaaS and SOA, Salesforce.com and CRM SaaS; Identity as a Service (IDaaS): Identity, Networked identity service classes, Identity system codes of conduct, IDaaS interoperability; Compliance as a Service (CaaS).

**CapacityPlanning:** Defining Baseline and Metrics: Baseline measurements, System metrics, Load Testing, Resource ceilings, Server and instance types; Network Capacity and Scaling.

**UNIT-IV: EXPLORING PLATFORM AS A SERVICE (PaaS) (10 Periods)**

**PaaS Application Frameworks:** Drupal, Eccentex AppBase 3.0, Long Jump, Square space, WaveMaker and Wolf Frameworks.

**Exploring Platform as a Service using Google Web Services:** Surveying the Google Application Portfolio, Google Toolkit and Working with the Google App Engine.

**Exploring Platform as a Service using Microsoft Cloud Services:** Exploring Microsoft Cloud Services, Defining the Windows Azure Platform, Windows Live: Windows Live Essentials, Windows Live Home and Windows Live for Mobile.

**UNIT-V: EXPLORING INFRASTRUCTURE AS A SERVICE (IaaS) (08 Periods)**

Understanding Amazon Web Services, Amazon Web Service Components and Services, Working with the Elastic Compute Cloud (EC2): Amazon Machine Images, Pricing models, System images and software, Creating an account and instance on EC2; Working with Amazon Storage Systems: Amazon Simple Storage System (S3), Amazon Elastic Block Store (EBS) and CloudFront; Understanding Amazon Database Services: Amazon SimpleDB, Amazon Relational Database Service (RDS) and Choosing a database for AWS.

**Total Periods: 45**

**Topics for Self-study are provided in the Lesson Plan.**

**TEXT BOOKS:**

1. Barrie Sosinsky, *Cloud Computing Bible*, Wiley India Pvt Ltd, 2011 (Reprint 2017).
2. Thomas Erl and RicardoPuttini, *Cloud Computing- Concepts, Technology and Architecture*, Pearson, 2014 (Seventh Impression 2017).

**REFERENCE BOOKS:**

1. Rajkumar Buyya, Christian Vecchiloa and S Thamarai Selvi, *Mastering Cloud Computing*, McGraw Hill Education, 2013 (Reprint 2017).
2. George Reese, *Cloud Application and Architectures*, O'Reilly, 2009 (Reprint 2017).

**ADDITIONAL LEARNING RESOURCES:**

1. "Exploring the Google Toolkit", <https://code.google.com/>, drafted on 23 December, 2019.
2. "Understanding Amazon Web Services", <https://aws.amazon.com/>, drafted on 23 December, 2019.
3. "Exploring Microsoft Cloud Services", <https://www.microsoft.com/windowsazure>, drafted on 23 December, 2019.

**III B. TECH. - II SEMESTER**  
**(19BT51501) MODERN CRYPTOGRAPHY**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Cryptographic protocols; Encryption techniques for confidentiality; Mathematics of symmetric and asymmetric algorithms; Hash functions for integrity; digital signature schemes.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply cryptographic protocols to ensure authentication in network systems.
- CO2: Analyze the efficiency of cryptographic techniques based on security attacks.
- CO3: Choose suitable key management scheme for efficient key exchange between the authenticated parties.
- CO4: Implement algorithms using information, complexity, and number theories for ensuring the security requirements-CIA.
- CO5: Evaluate Message Digest and Secure Hash Algorithms using hash functions for data Integrity.
- CO6: Analyze well known digital signature algorithms for securing communication.

**DETAILED SYLLABUS:**

**UNIT-I: FOUNDATIONS OF CRYPTOGRAPHY (08 Periods)**

**FOUNDATIONS OF CRYPTOGRAPHY:** Steganography, Substitution ciphers and Transposition Ciphers, One Time Pads. **Protocol Building Blocks:** Introduction to protocols, communications using symmetric Cryptography, One-Way Hash Functions, Communications Using Public-Key Cryptography, Digital Signatures with Encryption, Random and Pseudo-Random-Sequence Generation, **Basic Protocols:** Key Exchange, Authentication and key Exchange.

**UNIT-II: CRYPTOGRAPHIC TECHNIQUES (08 Periods)**

**CRYPTOGRAPHIC TECHNIQUES:** Key Management, Electronic Codebook Mode, Block Replay, Cipher Block Chaining Mode, Stream Ciphers, Self-Synchronizing Stream Ciphers, Cipher-Feedback Mode, Synchronous Stream Ciphers, Output-Feedback Mode, Counter Mode, Choosing a Cipher Mode, Interleaving, Block Ciphers versus Stream Ciphers.

**UNIT-III: MATHEMATICS FOR CRYPTOGRAPHIC ALGORITHMS (12 Periods)**

**MATHEMATICS FOR CRYPTOGRAPHIC ALGORITHMS:** Mathematical background: Information Theory, Complexity Theory, Number Theory, Factoring, Prime Number Generation, Discrete Logarithms in a Finite Field, Data **Encryption** Standard (DES), DES decryption, Security of DES, DES variants, Public Key Algorithms: RSA, Pholig-Hellman, RABIN, Elliptic Curve Cryptosystems.

**UNIT-IV: HASH FUNCTIONS (08 Periods)**

**HASH FUNCTIONS:** One Way Hash Functions, Snefru hash function, N- Hash, MD4, MD5, Secure Hash Algorithm (SHA), Security of SHA, One Way Hash Functions Using Symmetric Block Algorithms, Using Public-Key Algorithms, Message Authentication Codes (MAC).

**UNIT-V: DIGITAL SIGNATURES (09 Periods)**

**DIGITAL SIGNATURES:** Digital Signature Algorithm (DSA), Security of DSA, Discrete Logarithm Signature Schemes, Ongchnorr-Shamir, SCHNORR authentication and signature scheme, Diffie-Hellman Key exchange, Station-to-Station Protocol, Shamir's Three-Pass Protocol.

**Total Periods 45**

***Topics for self-study are provided in lesson plan***

**TEXT BOOKS:**

1. Bruce Schneier, "*Applied Cryptography: Protocols, Algorithms and Source Code in C*", John Wiley and Sons, New York, 2009.

**REFERENCE BOOKS:**

1. Alfred J Menezes, Paul C van Oorschot and Scott A. Vanstone, "*Handbook of Applied Cryptography*", CRC Press, New York, 2010.
2. Wenbo Mao, "*Modern Cryptography Theory and Practice*", Pearson Education, 2004

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.coursera.org/specializations/applied-crypto>
2. <https://www.udacity.com/course/applied-cryptography--cs387>
3. <https://www.classcentral.com/course/udacity-applied-cryptography-326>
4. <https://www.classcentral.com/course/udacity-applied-cryptography-326>
5. [https://wiki.openssl.org/index.php/Command\\_Line\\_Uutilities](https://wiki.openssl.org/index.php/Command_Line_Uutilities)
6. <https://www.sslshopper.com/article-most-common-openssl-commands.html>

**III B. Tech.–II Semester**  
**(19BT50503) CYBER SECURITY**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Cybercrime, Cyberoffenses, Phishing, Identity theft, Cybercrime in mobile and wireless devices, Organizational measures for handling mobile devices, Security implications on using mobile devices, Tools and methods used in cybercrime, Forensics of computer and handheld devices, Real-life examples of cybercrime.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze methods of cybercrime, cyberoffenses to maintain cybersecurity.
- CO2: Investigate tools used for cybercrime to protect computational assets.
- CO3: Apply appropriate authentication mechanisms to reduce attacks on mobile and wireless devices.
- CO4: Use appropriate cyberforensics tools and techniques to maintain cybersecurity.
- CO5: Recognize the need for cybersecurity and practice ethics to protect privacy, property rights in cyberspace.

**DETAILED SYLLABUS:**

**UNIT-I: CYBERCRIME (08 Periods)**

Cybercrime and information security, Cybercriminals, Classifications of cybercrimes, Need for Cyberlaws in Indian context, Legal perspectives of cybercrime, Indian perspective of cybercrimes, Cybercrime and the Indian ITA 2000, Positive aspects and weak areas of ITA 2000, Amendments made in Indian ITA 2000 for admissibility of e-records, Amendments to the Indian IT Act, Global perspective on cybercrimes, Intellectual property in cyberspace, Ethical dimension of cybercrimes.

**UNIT-II: CYBEROFFENSES (11 Periods)**

Categories of cybercrime, How criminals plan the attacks, Social engineering, Cyberstalking, Cybercafe and cybercrimes, Botnets, Attack vector, Cloud computing, Phishing – Methods, Techniques, Spear phishing, Phishing scams, Phishing toolkits, Spy phishing, Countermeasures; Identity Theft – Personally identifiable information, Types, Techniques, Countermeasures, Effacing online identity.

**UNIT-III: CYBERCRIME IN MOBILE AND WIRELESS DEVICES (07 Periods)**

Proliferation of mobile and wireless devices, Trends in mobility, Credit card frauds in mobile and wireless computing era, Security challenges posed by mobile devices, Registry settings for mobile devices, Authentication service security, Attacks on mobile/cell phones, Security implications of mobile devices for organizations, Organizational measures for handling mobile devices related security issues.

**UNIT-IV: TOOLS AND METHODS USED IN CYBERCRIME (10 Periods)**

Proxy servers and anonymizers, Password cracking, Keyloggers and spywares, Virus and worms, Trojan horses and backdoors, Steganography, DoS and DDoS attacks, SQL Injection, Buffer Overflow, Attacks on wireless networks.

**UNIT-V: CYBERFORENSICS, CYBERCRIME IN REAL-WORLD (09 Periods)**

**Forensics of Computer and Handheld Devices:** Cyberforensics, Cyberforensics and digital evidence, Forensics analysis of e-mail, Forensics and social networking sites, Forensics of handheld devices – Smartphone forensics, EnCase, Device Seizure, MOBILedit.

**Cybercrime examples, mini-cases, online scams:** Real-life examples - Official website of Maharashtra Government hacked, Indian banks lose millions of rupees, Game source code stolen; Mini-cases - Indian Case of online gambling, Indian case of intellectual property crime; Online scams - Cheque cashing scam, Charity scams.

**Total Periods: 45**

***Topics for self-study are provided in lesson plan***

**TEXT BOOK:**

1. Nina Godbole, Sunit Belapure, *Cyber Security: Understanding Cyber Crimes, Computer Forensics and Legal Perspectives*, Wiley, 2013.

**REFERENCE BOOKS:**

1. Nilakshi Jain, Ramesh Menon, *Cyber Security and Cyber Laws*, Wiley, 2020.
2. Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, *Cybersecurity Essentials*, 1<sup>st</sup> Edition, Sybex, 2018.
3. Erdal Ozkaya, *Cyber security: The Beginner's Guide*, 1<sup>st</sup> Edition, Packt Publishing, 2019.

**ADDITIONAL LEARNING RESOURCES:**

- Yuri Diogenes, Erdal Ozkaya, *Cybersecurity: Attack and Defense Strategies*, 2<sup>nd</sup> Edition, Packt Publishing, 2019.
- <http://www.ignou.ac.in/upload/Announcement/programmedetails.pdf>
- Alessandro Parisi, *Hands-On Artificial Intelligence for Cybersecurity*, Packt Publishing, 2019.



**III B. Tech. - II Semester**  
**(19BT61534) MODERN CRYPTOGRAPHY LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** - A course on Modern Cryptography

**COURSE DESCRIPTION:** Mono-alphabetic Ciphers; Poly-alphabetic Ciphers; Block modes; Block ciphers; Public Key Algorithms, Message Digest Algorithms, Diffie-Hellman Key Exchange; SHA; Digital Signature Standards.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Analyze attack resiliency of classical encryption algorithms to provide security.
- CO2. Develop block cipher modes of operations and stream ciphers to achieve confidentiality in network systems.
- CO3. Analyze the strength of RSA using cryptanalysis.
- CO4. Use Key Exchange algorithm to ensure security primitives.
- CO5. Implement different Message digest algorithms and DSS to achieve authentication.
- CO6. Work independently or communicate effectively in oral and written forms.

**LIST OF PROGRAMMING EXERCISES:**

1. Implement the following monoalphabetic Ciphers and analyze its attack resiliency.
  - a. Shift Cipher
  - b. Affine cipher
2. Implement the following Poly-alphabetic Ciphers and analyze its attack resiliency.
  - a. Hill cipher
  - b. Vigenere
3. Implement the following block cipher modes and analyze the role of Initialization Vector (IV)
  - a. counter mode
  - b. Output Feedback mode
4. Write a program to implement the Data Encryption Standard (DES).
5. Implement a stream cipher algorithm with running key generator.
6. Write a program to Implement RSA algorithm.
7. Write a program to find prime factors of a given large number and analyze the time complexity.
8. Write a program to determine the message digest of a given message using the SHA-1 algorithm.
9. Write a program to implement Diffie-Hellman Key Exchange mechanism.

10. Write a program to implement Digital Signature Standard.

**REFERENCE BOOKS:**

1. William Stallings, *Cryptography and Network Security: Principles and Practice*, Pearson Education, 7<sup>th</sup> Edition, 2017.
2. Douglas R. Stinson, *Cryptography: Theory and Practice*, CRC Press, 3<sup>rd</sup> Edition, 2005.

**ADDITIONAL LEARNING RESOURCES:**

<https://www.classcentral.com/course/udacity-applied-cryptography-326>

<https://www.classcentral.com/course/udacity-applied-cryptography-326>

[https://wiki.openssl.org/index.php/Command\\_Line\\_Uutilities](https://wiki.openssl.org/index.php/Command_Line_Uutilities)

<https://www.sslshopper.com/article-most-common-openssl-commands.html>

**IV B. Tech. – I Semester**  
**(19BT61509) IoT SECURITY**

|            |            |             |   |   |   |   |
|------------|------------|-------------|---|---|---|---|
| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Securing the Internet of Things; Cryptographic Fundamentals for IoT; Identity & Access Management Solutions for IoT; Mitigating IoT Privacy Concerns; Cloud Security for IoT

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze Attacks, threats and vulnerabilities to secure IoT devices.
- CO2: Design IoT messaging and communication protocols using Cryptographic primitives
- CO3: Apply authentication credentials and Identity Access Management infrastructure to manage IoT
- CO4: Analyze privacy concerns in IoT devices by using PIA
- CO5: Examine IoT threats in the cloud for effective utilization of cloud services
- CO6: Analyze different cloud service providers to IoT computing

**DETAILED SYLLABUS:**

**UNIT-I: Securing the Internet of Things (09 Periods)**

Security Requirements in IoT Architecture - Security in Enabling Technologies -Security Concerns in IoT Applications. Security Architecture in the Internet of Things -Security Requirements in IoT - Insufficient Authentication/Authorization – Insecure Access Control - Threats to Access Control, Privacy, and Availability - Attacks Specific to IoT. Vulnerabilities – Secrecy and Secret-Key Capacity -Authentication/Authorization for Smart Devices - Transport Encryption – Attack & Fault trees

**UNIT-II: Cryptographic Fundamentals for IoT (09 Periods)**

Cryptographic primitives and its role in IoT – Encryption and Decryption – Hashes – Digital Signatures – Random number generation – Cipher suites – key management fundamentals – cryptographic controls built into IoT messaging and communication protocols – Zigbee, Bluetooth-LE, Near Field Communication (NFC).

**UNIT-III: Identity & Access Management Solutions for IoT (09 Periods)**

Identity lifecycle – authentication credentials– passwords, Symmetric keys, certificates, Biometrics, IoTIAMinfrastructure Authorization and Access controls within publish/Subscribe protocols, access controls within communication protocols

**UNIT-IV: Mitigating IoT Privacy Concerns (09 Periods)**

Privacy challenges introduced by IoT- A complex sharing environment- wearable's, smart homes, Guiding to perform an IoT PIA-Authorities, characterizing collected information, use of collected information, Security, Notice, Data retention Information sharing, redress, auditing and accountability

**UNIT-V: Cloud Security for IoT****(09 Periods)**

Cloud services and IoT – offerings related to IoT from cloud service providers – Cloud IoT security controls – An enterprise IoT cloud security architecture – New directions in cloud enabled IoT computing

**Total Periods: 45**

***Topics for self-study are provided in lesson plan***

**TEXT BOOK:**

1. Practical Internet of Things Security: Design a security framework for an Internet connected ecosystem, Brian Russell and Drew Van Duren, 2<sup>nd</sup> Edition 2016.

**REFERENCE BOOKS:**

1. Security and Privacy in Internet of Things (IoTs): Models, Algorithms, and Implementations, Fei Hu, CRC Press 2016.
2. Securing the Internet of Things Elsevier

## IV B. TECH. – I SEMESTER

### (19BT61502) INFORMATION SECURITY

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 30         | 70         | 100         | 3 | - | - | 3 |

#### PRE-REQUISITES: -

**COURSE DESCRIPTION:** Computer security; Need of Security; Access Control; Security policies; Software vulnerabilities; Secure Electronic transactions; Secure socket layer; transport layer security; Privacy.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the security requirements like confidentiality, integrity, and availability to secure network assets from threats and attacks.
- CO2: Analyze virus, malicious software and worms for detecting distributed Denial of service attacks.
- CO3: Apply handshaking, alert and change cipher spec protocols and Coding function to secure SSL and TLS.
- CO4: Apply PGP model and canonical forms to secure E-Mail data at transport layer.
- CO5: Design firewall to secure the system by applying various intrusion detection systems.
- CO6: Apply privacy techniques to protect information in the network.

#### DETAILED SYLLABUS:

##### UNIT-I: INTRODUCTION (08 Periods)

Computer Security Concepts, the OSI Security Architecture, Security Attacks, Security Mechanism, Standards.

**Malicious Software:** Types of Malicious Software, Viruses, Worms, Distributed Denial of Service Attacks.

##### UNIT-II: SECURITY AT TRANSPORT LAYER: SSL & TLS (09 Periods)

Web Security Consideration, Secure Socket Layer and Transport Layer Security, Transport Layer Security, HTTPS, Secure Shell.

**Wireless Network Security:** IEEE 802.11 Wireless LAN Overview, IEEE 802.11i LAN Security, Wireless Application Protocol Overview, Wireless Transport Layer Security, WAP end-to-end Security

##### UNIT-III: SECURITY AT APPLICATION LAYER: PGP AND S/MIME (08 Periods)

Pretty Good Privacy, S/MIME, Domainkeys Identified Mail

**IP Security:** IP Security Overview, IP Security Policy, IP Security Architecture, Encapsulating Security Payload, Combining Security Associations, Internet Key Exchange.

##### UNIT-IV: INTRUDERS AND FIREWALLS (08 Periods)

**Intrusion Detection System:** Intruders, Intrusion Detection, Password Management.

**Firewalls:** The Need for Firewalls, Firewall Characteristics, Types of Firewalls, Firewall Basing, Firewall location and configuration.

##### UNIT-V: PRIVACY (09 Periods)

Evade Traffic analysis, Tunnel SSH through Tor, Encrypt you file seamlessly, Guard against Phishing, Use the web with fewer passwords, Encrypt your E-mail with Thunderbird, Encrypt you E-mail in Mac OS X

**Total Periods: 45**

**Topics for self-study are provided in lesson plan.**

**TEXT BOOKS:**

1. William Stallings "*Network Security Essentials (Applications and Standards)*", 4<sup>th</sup> Edition, Pearson Education 2011.
2. Andrew Lockhart "*Information security Hacks (Tips and Tools for protecting your privacy)*", 2<sup>nd</sup> Edition, 2004.

**REFERENCE BOOKS:**

1. Behrousz A Forouzan, D Mukhopadhyay, "Cryptography and network Security", McGraw Hill.
2. Network Security – Private Communication in a Public World by Charlie Kaufman, Radia Perlman and Mike Speciner, Pearson/PHI.

**ADDITIONAL RESOURCES:**

1. [http://www.inf.ufsc.br/~bosco.sobral/ensino/ine5680/material-cripto-seg/20141/Stallings/Stallings\\_Cryptography\\_and\\_Network\\_Security.pdf](http://www.inf.ufsc.br/~bosco.sobral/ensino/ine5680/material-cripto-seg/20141/Stallings/Stallings_Cryptography_and_Network_Security.pdf).
2. <http://www.ijcsmc.com/docs/papers/January2015/V4I1201544.pdf>.
3. <http://nptel.ac.in/syllabus/106105031/>

**IV B. TECH. – I SEMESTER**  
**(19BT71534) INFORMATION SECURITY LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** - A course on Information Security.

**COURSE DESCRIPTION:** Windows Firewall Security Features, Introduction to wireshark tool, Pretty Good Privacy (PGP), Intrusion Detection System, SSL Certificate, and TLS.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the tools and techniques to ensure the information security and privacy for network applications.
- CO2: Analyze SSL Certificate and encryption in web applications for security.
- CO3: Analyze SSL and TLS protocols to secure TCP connections.
- CO4: Implement IP Packet filtering for blocking in-bound packets.
- CO5: Work independently or communicate effectively in oral and written forms.

**List of Exercises/List of Experiments:**

1. Find the Packet Information using Wireshark on our network.
2. Simulate traffic analyzing using wireshark.
3. Study of SSL (HTTPS) over HTTP to secure TCP connections.
4. Simulate Transport Layer Security protocol.
5. Create a simple web application and deploy it in Apache tomcat server and secure it using SSL certificates.
6. Simulate Pretty Good Privacy security protocol for email messages and individual files.
7. Simulate IP Packet filtering at host system in user Network.
8. Study windows firewall security features on the system allotted to you.
9. Create firewalls using ip tables in linux.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Computer Security: Principles and Practices, William Stallings and Lawrie Brown, Pearson Education, ISBN 13-9780134794396
2. Computer Security: Art and Science, by Matt Bishop, Pearson Education, ISBN:9788177584257

**SOFTWARE/Tools used:**

- Windows Fire Wall
- PGP
- SSL
- Tomcat 7.0.104
- Snort
- Java
- Wireshark

**ADDITIONAL LEARNING RESOURCES:**

[https://www.cengage.com/resource\\_uploads/downloads/1111138214\\_259146.pdf](https://www.cengage.com/resource_uploads/downloads/1111138214_259146.pdf)

<https://www.cmu.edu/iso/aware/presentation/tepperphd.pdf>

<https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-12r1.pdf>

<https://www.cs.unibo.it/babaoglu/courses/security/resources/documents/intro-to-crypto.pdf>

<http://www.cs.kent.edu/~mallouzi/ccn%20Spring%202014/>



## **MINOR DEGREE IN VLSI AND EMBEDDED SYSTEMS**

**Offering Department:** ELECTRONICS AND COMMUNICATION ENGINEERING

**Students of Eligible Branches:** CSE, CSSE, IT, EEE, EIE, ME and CE

### **COURSE STRUCTURE**

| Year & Semester                                | Course code | Course title                           | Contact Periods per week |   |   |   | Scheme of Examination<br>Max. Marks |            |             |
|------------------------------------------------|-------------|----------------------------------------|--------------------------|---|---|---|-------------------------------------|------------|-------------|
|                                                |             |                                        | L                        | T | P | C | Int. Marks                          | Ext. Marks | Total Marks |
| III B.Tech.<br>I-Sem<br>(2 Theory+<br>1 Lab)   | 19BT30404   | Switching Theory and Logic Design      | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT50403   | VLSI Design                            | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT60402   | Microcontrollers                       | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT50433   | Digital design Lab                     | -                        | - | 2 | 1 | 40                                  | 60         | 100         |
| III B.Tech.<br>II-Sem.<br>(2 Theory+<br>1 Lab) | 19BT60404   | ARM and AVR Microcontrollers           | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT60409   | Testing and Testability                | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT70408   | Low Power CMOS VLSI Design             | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT60415   | Microprocessors and Microcontrollers   | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT60434   | VLSI Lab                               | -                        | - | 2 | 1 | 40                                  | 60         | 100         |
| IV B.Tech.<br>I-Sem.<br>(1 Theory+<br>1 Lab)   | 19BT70401   | Embedded Systems                       | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT70409   | Real Time Systems                      | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT70414   | System-on-Chip Design and verification | 3                        | - | - | 3 | 40                                  | 60         | 100         |
|                                                | 19BT70432   | Embedded Systems Lab                   | -                        | - | 2 | 1 | 40                                  | 60         | 100         |

**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

**III B. Tech. – I Semester**  
**(19BT30404) SWITCHING THEORY AND LOGIC DESIGN**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Number system and Boolean algebra; Minimization; Analysis and synthesis of digital circuits; Asynchronous Sequential Logic & Programmable Memories.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate the knowledge of Boolean Algebra, various number systems and Logic gates to implement Digital Circuits.
- CO2: Design subsystem by Analyzing combinational & sequential logic circuits for providing optimal solutions
- CO3: Develop Asynchronous sequential logic and programmable memories for societal needs.
- CO4: Design various programmable logic arrays using logic gates

**DETAILED SYLLABUS:**

**UNIT-I: NUMBER SYSTEMS AND BOOLEAN ALGEBRA (10 Periods)**

Digital systems, Binary Numbers, Number base conversions, Complements of numbers, Signed binary numbers, Binary codes, Error detection and correction codes. Boolean Algebra-Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, logic operations & Logic gates.

**UNIT-II: GATE LEVEL MINIMIZATION (08 Periods)**

The map method, four variable, Five variable K-map, POS & SOP Simplification, Don't care conditions, NAND & NOR Implementation, Other two level Implementation, Ex-or Function, Tabular Method- Simplification of Boolean function using tabulation Method.

**UNIT-III: COMBINATIONAL LOGIC DESIGN (09 Periods)**

Combinational circuits, Analysis & Design procedure, Binary Adder-Sub tractor, Decimal Adder, Binary Multiplier, Magnitude comparator, Decoder, Encoders, Multiplexers and De- Multiplexers.

**UNIT-IV: SEQUENTIAL LOGIC DESIGN (11 Periods)**

Sequential Circuits, Latches, Flip-Flops, Analysis of Clocked sequential circuits, State Reduction & Assignment, Design procedure, Introduction to Registers-Universal Shift Registers, Introduction to Counters, Ripple Counters-Binary and BCD Ripple Counter , Synchronous counters-Binary, Up-Down Binary Counter and BCD Counter and Other counters-Ring Counter, Johnson Counter.

**UNIT-V: ASYNCHRONOUS SEQUENTIAL LOGIC AND PROGRAMMABLE MEMORIES  
(07 Periods)**

Introduction, Analysis procedure, Design Procedure-Primitive Flow Table, Reduction of State and Flow Tables-Implication Table and Implied States, Hazards, ROM, PLA, PAL.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOK:**

1. M. Morris Mano, Michael D. Ciletti, *Digital Design With an Introduction to the Verilog HDL*, Pearson, 5<sup>th</sup> edition, 2017.

**REFERENCE BOOKS:**

1. A. Anand Kumar, *Switching Theory and Logic Design*, PHI Learning Private Limited, 3<sup>rd</sup> edition, India, 2017.
2. Charles H. Roth, Jr. and Larry L. Kinney, *Fundamentals of Logic Design*, Cengage Learning, 7<sup>th</sup> edition, 2015

### III B. Tech. – I Semester (19BT50403) VLSI Design

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Switching Theory and Logic Design/Digital Logic Design.

**COURSE DESCRIPTION:** Logic Families; CMOS Technology; Stick Diagrams and Layouts; Subsystem design; Programmable Interconnect structures; Memories.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze logic families, steady state and dynamic characteristics of CMOS, to improve performance characteristics of digital ICs.
- CO2: Analyze electrical properties of MOS circuits for VLSI/ULSI chip fabrication.
- CO3: Develop stick diagrams and layouts of CMOS circuits for miniaturization by analyzing gate delays and scaling effects.
- CO4: Design subsystems for High speed digital electronics to compensate tradeoff among area, speed and power requirements.

#### DETAILED SYLLABUS:

#### UNIT-I: DIGITAL LOGIC FAMILIES (08 Periods)

Introduction to logic families, RTL, DTL, Transistor-Transistor logic, Emitter Coupled Logic, I<sup>2</sup>L, CMOS logic, CMOS steady state and dynamic electrical behavior.

#### UNIT-II: FABRICATION AND ELECTRICAL PROPERTIES OF MOS (10 Periods)

Fabrication Process for NMOS and CMOS technology, Basic Electrical Properties of MOS:  $I_{ds} - V_{ds}$  relationships, Second order effects of MOSFETs-Latch up, Hot carrier Effects, channel length modulation, Threshold Voltage  $V_T$ ,  $g_m$ ,  $g_{ds}$  and  $\omega_0$ ; Pass Transistor, NMOS inverter, Pull up to pull down ratio for an NMOS inverter, CMOS Inverter

#### UNIT-III: CMOS CIRCUIT DESIGN PROCESS (10 Periods)

VLSI design flow, MOS layers, stick diagrams, NMOS design style, CMOS design style, lambda based design rules, layouts for inverters, sheet resistance, capacitances of layers, Gate delays, Delay estimation, Scaling, Limitations of Scaling.

#### UNIT-IV: SUBSYSTEM DESIGN - I (08 Periods)

Adders – Transmission based Adder, Carry look-ahead adder, Manchester carry chain adder, Carry Skip Adder, Carry Select Adder; Barrel Shifter, Multipliers – Array Multiplier, Booth Multiplier; ALUs.

**UNIT-V: SUBSYSTEM DESIGN - II****(09 Periods)**

Counters- Synchronous and Asynchronous Counter; High Density Memory Elements - Design Approach, FPGAs, Programmable Interconnect structures - Fusible links, Antifuse via link, UV Erasable, Electrically Erasable; CPLDs, Cell based Design Methodology.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Kamran Eshraghian, Douglas A. Pucknell and sholeh Eshraghian, *Essentials of VLSI Circuits and Systems*, PHI, 2005.
2. Morris Mano, *Digital Design*, Prentice Hall, 3<sup>rd</sup> Edition, 2003 .

**REFERENCE BOOKS:**

1. John F.Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4<sup>th</sup> Edition, 2008.
2. John M. Rabaey, *Digital Integrated Circuits: A Design Perspective*, PHI, 2<sup>nd</sup> Edition, 2003.

**III B. Tech. - I semester**  
**(19BT60402) MICROCONTROLLERS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Switching Theory and Logic Design/Digital Logic Design.

**COURSE DESCRIPTION:** 8051 Microcontroller - Architecture, programming, interrupts and applications; PIC microcontroller architecture, Interrupts and timers of PIC microcontroller, interfacing

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze Architectural features and Instruction Set of 8051 for control applications.
- CO2: Analyze PIC18 Architecture and Instruction Set to develop computing applications.
- CO3: Develop Programs for PIC18 using ports, timers and associated on Chip resources for Specified Applications.
- CO4: Design microcomputer based systems with the knowledge of Interfaces and Peripherals of PIC18 to Solve various engineering problems.

**DETAILED SYLLABUS:**

**UNIT-I: 80C51/31 (10 Periods)**

Microprocessors vs Microcontrollers, 8051 Architecture, Internal and external memories, Addressing modes, Timers/Counters structure & configuration, Instruction set of 8051, simple programs using 8051.

**UNIT-II: PIC ARCHITECTURE & PROGRAMMING (10 Periods)**

Architecture of PIC18, Register Organization, Memory Organization - ROM space & RAM; Data formats & Directives, Instruction Set: Arithmetic, Logic, branching, Bit wise, bank switching, Simple PIC Programs.

**UNIT-III: PORTS, TIMERS & PROGRAMMING (10 Periods)**

Pin description of PIC18F452, Basic Port Structure, I/O port programming; Macros and modules, Structure of Timer 0 & its Programming using Assembly and C, Counter programming, Structure of timers 1, 2 and 3 & their Programming.

**UNIT-IV: PIC - SERIAL PORT AND INTERRUPTS****(07 Periods)**

Basics of communication – Serial/Parallel, RS232 & PIC18 connection to RS232, Serial Port Structure & programming; PIC18 interrupts, Programming timer interrupts, Programming serial interrupts.

**UNIT-V: PIC INTERFACING****(08 Periods)**

7 segment LED and LCD interfacing, keyboard interfacing, interfacing ADC, DAC, Interfacing DC motor, stepper motor, PWM using CCP.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Muhammad Ali Mazidi and Janice Gillespie Mazidi and Rollin D, *The 8051 Microcontroller and Embedded Systems-using assembly and C*, PHI, 2006/ Pearson New International Edition 2014
2. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny causey, *PIC Microcontroller and Embedded Systems: Using C and PIC18*, Pearson Education, 2015.

**REFERENCE BOOKS:**

1. Kenneth J. Ayala, *The 8051 Microcontroller-Architecture, Programming & Applications*, 3<sup>rd</sup> Edition, Cengage learning, June 2007.
2. Ramesh S. Gaonkar, *Fundamentals of Microcontrollers and Applications in Embedded Systems (With PIC18 Microcontroller Family)*, Penram International, 2010.
3. M Rafiquzzaman, *Microcontroller Theory And Applications With The PIC*, Wiley India Publications, March 2014

**ADDITIONAL LEARNING RESOURCES:**

1. <http://crystal.uta.edu/~zaruba/CSE3442/>
2. <https://owd.tcnj.edu/~hernande/ELC343/>
3. <http://www.ciebookstore.com/Content/Images/uploaded/PIC18-Study-Guide-CIE.pdf>

**III B. Tech. – I Semester**  
**(19BT50433) DIGITAL DESIGN LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** Courses on Switching Theory and Logic Design/Digital Logic Design & Electronic Devices and Circuits.

**COURSE DESCRIPTION:** Design and verification of Digital Circuits, PCB Design of Electronic Circuits.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Design and Realize various Digital applications by using ICs for societal needs.
- CO2: Implement Electronic Circuits using Passive and Active elements for specified applications.
- CO3: Analyze performance parameters for PCB designed circuits using a simulation tool.
- CO4: Work independently and in teams to solve problems with effective Communication.

**LIST OF EXERCISES/LIST OF EXPERIMENTS:**

**Part-A: Realize the Following in Hardware**

(Minimum **Six** Experiments are to be conducted)

1. Realize gates using NAND & NOR gates.
2. Optimize and Realize a given Boolean Function.
3. Design and Realize BCD to Excess-3 Code Converter.
4. Design and Realize Adder and Subtractor using Multiplexer based on logic gates/ IC74153.
5. Design and Realize a BCD to 7-Segment Decoder using Logic Gates/ ICs.
6. Design and Realize a Hexadecimal to Binary Encoder using IC74148 and IC74157.
7. Design and Realize a Sequence Generator using IC7495.
8. Design and Realize Asynchronous and Synchronous counters using IC7476 (JK-Flip Flop).

**Part-B: PCB Layout Design of Electronic Circuits using TINAPRO/ eSIM-KiCAD/ TinyCAD/ Fritzing Software**

(Minimum **Four** Experiments are to be conducted)

1. RC Filter.
2. Half Wave Precision Rectifier.
3. Zener Regulator.
4. Diode Clamper.
5. Transistor as a Switch.
6. CMOS Inverter.



**REFERENCE BOOKS/LABORATORY MANUALS:**

1. John F. Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4<sup>th</sup> Edition, 2008.

**SOFTWARE/Tools used:**

TINAPRO/ eSIM-KiCAD/ TinyCAD PCB Design Tool.

**ADDITIONAL LEARNING RESOURCES:**

1. [http://vlabs.iitb.ac.in/vlabsdev/vlab\\_bootcamp/bootcamp/cool\\_developers/index.htm](http://vlabs.iitb.ac.in/vlabsdev/vlab_bootcamp/bootcamp/cool_developers/index.htm)  
I - Virtual labs for digital circuits
2. <https://nptel.ac.in/courses/108/108/108108031/>
3. [https://swayam.gov.in/nd2\\_aic20\\_sp59/preview](https://swayam.gov.in/nd2_aic20_sp59/preview)

### III B. Tech. – II Semester (19BT60404) **ARM AND AVR CONTROLLERS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Switching Theory and Logic Design/Digital Logic Design, & Microcontrollers

**COURSE DESCRIPTION:** ARM Architecture; ARM Instruction Set; ARM Programming; AVR Architecture; AVR Programming in Assembly Language & C

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze ARM Architectures and Instruction Set to develop fundamental Programs.
- CO2: Develop efficient ARM based Prototypes by analyzing modes of ARM operation to program ARM Cortex M3 at Assembly and high levels.
- CO3: Realize efficient Embedded Systems with an understanding of limitations by evaluating architectural features of AVR Family Microcontrollers .
- CO4: Apply Programming techniques at Assembly and High Level to develop industry standard microcontroller based systems.

#### **DETAILED SYLLABUS:**

#### **UNIT-I: INTRODUCTION TO ARM ARCHITECTURE (09 Periods)**

Introduction to ARM family of processors and controllers, Architecture of ARM Cortex M3, Cortex M3 fundamentals, registers, Operation modes, ARM Instruction Set: Data transfer, Data Processing Call & Branch, Bit Manipulation, Pseudo Instructions and other useful instructions in Cortex M3, ARM Assembly Language Programming.

#### **UNIT-II: THUMB PROGRAMMING & OTHER ARM FEATURES (09 Periods)**

Thumb Instruction Set, ARM Mode & Thumb mode Programming, ARM Programming in C. Memory system, memory map, Memory system attributes, ARM Pipeline, Exception types, Cortex M3 Processor applications.

#### **UNIT-III: INTRODUCTION TO AVR MICROCONTROLLER (09 Periods)**

Overview of AVR family, AVR Microcontroller architecture, status register, Special function registers, RAM, ROM & EEPROM space, On-Chip peripherals, ATmega32 pin configuration & function of each pin, Fuse bits of AVR.

#### **UNIT-IV: AVR ASSEMBLY LANGUAGE PROGRAMMING (10 Periods)**

AVR data types and assembler directives, Addressing modes of AVR, Data transfer, Arithmetic, Logic and Compare, Rotate and Shift, Branch and Call instructions, AVR studio setup for assembly language programming, AVR I/O Port Programming, Time delay loop, Look-up table, Bit addressability, MACROS, Intel HEX file.

**UNIT-V: AVR PROGRAMMIN IN C****(08 Periods)**

AVR Data types, AVR I/O port programming, Timer programming, Input capture and Wave Generator, PWM programming External Interrupt programming, ADC programming, EEPROM programming.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Joseph Yiu, *The Definitive Guide to the ARM Cortex-M3 & M4*, Elsevier, 3<sup>rd</sup> Edition, January 2014.
2. Muhammad Ali Mazidi, Sarmad Naimi and SepehrNaimi, *The AVR Microcontroller and Embedded Systems Using Assembly and C*, Pearson Education, January 2014.

**REFERENCE BOOKS:**

1. Ramesh Gaonkar, *Fundamentals of Microcontrollers and Applications in Embedded Systems (with the PIC18 Microcontroller Family)*, Penram International, First edition, 2010
2. Andrew Sloss, Dominic Symes, Chris Wright, *ARM System Developer's Guide: Designing and Optimizing System Software* (The Morgan Kaufmann Series in Computer Architecture and Design), October 2004.
3. AVR ATmega32 data sheet

**III B. Tech. – II Semester**  
**(19BT60409) TESTING AND TESTABILITY**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on VLSI Design.

**COURSE DESCRIPTION:** Need for Testing, Types of Testing, Fault Modeling, Test Methods for evaluation, Test Generation Algorithms, Delay Tests, IDDQ Tests, Ad-Hoc DFT Methods, Scan Based Designs, Built-In Self Test.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the importance of Testing, fault models and related theorems.
- CO2: Analyze various test methods, combinational and sequential circuit test generation Algorithms for Functional Verification of Digital Circuits.
- CO3: Analyze delay test algorithms and IDDQ test algorithms for at-speed testing of CMOS Integrated Circuits.
- CO4: Understand the concepts and architectures for Built-In Self Test to satisfy industry specifications.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO TESTING (09 Periods)**

Role of Testing, VLSI Technology Trends Affecting Testing, Types of Testing, Test Economics, Yield, Fault Modeling, Fault Equivalence, Fault Collapsing, Fault Dominance and Checkpoint Theorem.

**UNIT-II:- TEST METHODS (10 Periods)**

Simulation for Design Verification and Test Evaluation, Algorithms for Fault Simulation – Serial, Parallel, Deductive, Concurrent Fault Simulations; Fault Sampling.

**UNIT-III: COMBINATIONAL AND SEQUENTIAL CIRCUIT TEST GENERATION (11 Periods)**

ATPG Algorithms – D-Algorithm, PODEM, FAN; Test Compaction, Time Frame Expansion Method – Nine-Value Algorithm; Simulation Based Sequential ATPG - CONTEST Algorithm.

**UNIT-IV: DELAY AND IDDQ TESTS (06 Periods)**

Delay Test – Path-Delay Test, Transition Faults, At-Speed Testing; IDDQ Test – Limitations, Delta IDDQ Testing, IDDQ Built-in Current Testing.

**UNIT-V: DESIGN FOR TESTABILITY (09 Periods)**

Ad-Hoc DFT Methods, Full Scan Design, Partial Scan Design, Random Logic BIST – Test-per-Clock and Test-per-Scan BIST Systems; Boundary Scan Standard – TAP Controller and Port.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOK:**

1. Michael L. Bushnell, Vishwani D. Agrawal, "*Essentials of Electronic Testing for Digital, Memory and Mixed-Signal VLSI Circuits*", Kluwer Academic Publishers, Springer US, New York, 2006.

**REFERENCE BOOKS:**

1. Miron Abramovici, Melvin A. Breur, Arthur D. Friedman, "*Digital Systems Testing and Testable Design*", Wiley, Jaico Publishing House, 1<sup>st</sup> Edition, 2001.
2. Alfred L. Crouch, "*Design for Test for Digital ICs & Embedded Core Systems*", Pearson Education, 1<sup>st</sup> Reprint Edition, 2007.
3. Robert J. Feigate, Jr., Steven M. McIntyre, "*Introduction to VLSI Testing*", Prentice Hall, 1st Illustrated Edition, 1998.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.classcentral.com/course/swayam-digital-vlsi-testing-7956>

### III B. Tech. - II semester (19BT70408) **LOW POWER CMOS VLSI DESIGN**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on VLSI Design.

**COURSE DESCRIPTION:** Basic Principles; Methodologies and techniques of CMOS Circuit Designs; Need For Low Power VLSI Design; Principles Of Low Power Circuit Design; Simulation Analysis of Low Power; Logic and Circuit Analysis; Special Techniques and Advanced Techniques Of Low Power Design; Performance Management in Architecture or System level.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to

CO1: Demonstrate low power design requirements for CMOS VLSI circuits.

CO2: Analyze and estimate power at Logic and Circuit abstraction levels of digital systems.

CO3: Develop alternate circuits and logic for analysis of low power circuits.

CO4: Apply special and advanced low power techniques at circuit, architecture and system levels to develop CMOS devices.

#### **DETAILED SYLLABUS:**

#### **UNIT-I: BASICS OF LOW POWER DESIGN (07 Periods)**

Needs For Low Power VLSI Chips, Charging And Discharging Capacitances, Short Circuit Current in CMOS, CMOS Leakage Current, Static Current, Basic Principles Of Low Power Design, Low Power Figure Of Merits, Low Power VLSI Design Limits.

#### **UNIT-II: POWER ANALYSIS AND ESTIMATION (10 Periods)**

Spice Circuit Simulation, Discrete Transistor Modeling and Analysis, Gate Level Logic Simulation, Architecture Level Analysis, Data Correlation Analysis, Monte Carlo Simulation.

#### **UNIT-III: LOW POWER CIRCUITS (11 Periods)**

**CIRCUIT ANALYSIS:** Transistor and Gate Sizing, Equivalent Pin Ordering, Network Restructuring and Reorganization, Special latches and Flip flops.

**LOGIC ANALYSIS:** Gate Reorganization, Signal Gating, Logic Encoding, State Machine Encoding, Pre computation Logic.

#### **UNIT-IV: SPECIAL TECHNIQUES (08 Periods)**

Power Reduction in Clock Networks, CMOS Floating Node, Low Power Bus, Delay Balancing, Low Power Techniques for SRAM.

#### **UNIT-V: ARCHITECTURE, SYSTEM & ADVANCED TECHNIQUES (9 Periods)**

Power and Performance Management, Switching Activity Reduction, Adiabatic Computation, Pass Transistor Logic Synthesis, Asynchronous Circuit.

**Total Periods: 45**

**Topics for Self-Study are provided in the Lesson Plan**

**TEXT BOOK:**

1. Gary Yeap, *Practical Low-Power Digital VLSI Design*, Springer Publication, 2012.

**REFERENCE BOOKS:**

1. A.P.Chandrakasan, R.W.Broadersen, *Low Power Digital CMOS Design*, Kluwer, Springer US, 2012.
2. Kaushik Roy, Sharat Prasad, *Low-Power CMOS VLSI Circuit Design*, Wiley Student Edition, 2009.

**ADDITIONAL LEARNING RESOURCES:**

<https://nptel.ac.in/courses/106/105/106105034/>  
<https://nptel.ac.in/courses/117/101/117101004/>

**III B. Tech. - II semester**  
**(19BT60415) MICROPROCESSORS AND MICROCONTROLLERS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Switching Theory and Logic Design/Digital Logic Design.

**COURSE DESCRIPTION:** Architecture, Instruction set and programming of 8086; Programmable interfacing devices - architecture and programming; Interfacing Memory and I/O devices with 8086; 8051 Microcontroller - Architecture, programming, interrupts and applications.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze Architectural features and Instruction Set of 8086 for computing applications.
- CO2: Analyze Techniques for Interfacing various peripherals to realize Microcomputer based systems.
- CO3: Analyze Architectural features and Instruction Set of 8051 for control applications.
- CO4: Design various embedded applications programming 8051 on-chip Resources and by interfacing various peripherals.

**DETAILED SYLLABUS:**

**UNIT-I: 8086 ARCHITECTURE AND PROGRAMMING (10 Periods)**

Microprocessor Evolution, Review of Intel 8085, 8086 internal Architecture - register organization, memory segmentation, memory organization; Introduction to programming the 8086 - Assembler directives, addressing modes, instruction set, simple programs, procedures and macros;

**UNIT-II: 8086 INTERFACING AND INTERRUPTS (08 Periods)**

Pin description, minimum & maximum mode operation of 8086, timing diagram. Interfacing memory (RAM and EPROM) to 8086. 8086 Interrupts - types and interrupt responses, Interrupt vector table, priority of interrupts; 8259 priority interrupt controller - architecture, system connections and cascading, initialization of 8259;

**UNIT-III: PROGRAMMABLE DATA COMMUNICATION DEVICES (11 Periods)**

Introduction to serial and parallel communication, methods of parallel data transfer. 8255 PPI - Internal architecture and system connections, operational modes and initialization, interfacing stepper motor, ADC, DAC, Optical Shaft Encoder; Methods of serial data transfer, 8251 USART - architecture and its initialization, sending and receiving characters; Serial communication standard - RS232C, USB; Architecture and operation of 8257 DMA controller.

**UNIT-IV: MICROCONTROLLERS AND PROGRAMMING (08 Periods)**

Microcontroller Vs. General purpose microprocessor, 8051/8052 Microcontroller - architecture, features, register organization, pin diagram, internal and external memories & their interfacing, instruction set, addressing modes, simple programs;



**UNIT-V: 8051 INTERFACING****(08 Periods)**

Timer/Counters – Registers, modes and programming; Serial communication – registers, programming 8051 for serial communication; Interrupts – registers, programming; 8051 applications – Interfacing key board, LEDs and LCD;

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Douglas V. Hall, *Microprocessors and Interfacing: Programming and Hardware*, Tata McGraw-Hill, revised 2<sup>nd</sup> Edition, 2006.
2. Muhammad Ali Mazidi and Janice Gillispie Mazidi, *The 8051 Microcontroller and Embedded Systems*, Prentice Hall of India, 2000.

**REFERENCE BOOKS:**

1. A.K. Ray and K.M. Bhurchandi, *Advanced Microprocessors and Peripherals-Architecture, Programming and Interfacing*, Tata McGraw Hill, 2002 reprint.
2. Kenneth J. Ayala, *The 8051 microcontroller, Thomson Delmar learning*, 3<sup>rd</sup> Edition, 2004.

### III B. Tech. – II Semester (19BT60434) VLSI LAB

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A course on Switching Theory and Logic Design/ Digital Logic Design.

**COURSE DESCRIPTION:** Design and verification of various combinational & sequential digital circuits through source code.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze simplification methods in logic circuits and perform desired logical operations optimally using logic gates.
- CO2: Design combinational circuits to perform arithmetic operations, data encoding and decoding, Multiplexing and Demultiplexing for engineering applications.
- CO3: Design sequential circuits for realizing counters and registers using flip-flops.
- CO4: Develop source code for Advanced Digital Design and perform functional verification.
- CO5: Work independently or in teams to solve problems with effective Communication.

#### LIST OF EXERCISES/LIST OF EXPERIMENTS:

##### Part-A: Basic Digital Design

(Minimum **SEVEN** experiments are to be conducted)

Develop the source code for the following circuits and their test bench for verification. Also perform simulation, synthesis for given specifications

1. Buffer and basic gates.
2. Flip flops - RS, D, JK, T.
3. Adders and Subtractors.
4. 8-3 Encoder.
5. 3-8 Decoders.
6. 8x1 Multiplexer and 2x4 Demultiplexer.
7. Arithmetic and Logic Unit.
8. Synchronous & Asynchronous counter.
9. 4 Bit Comparator

## **Part-B: Advanced Digital Design (FPGA Implementation)**

(Minimum **THREE** Experiments are to be conducted)

1. Write Verilog code for the design of 8-bit
  - i. Carry Ripple Adder
  - ii. Carry Look Ahead adder
  - iii. Carry Save Adder
2. Write Verilog Code for the design of 8-bit
  - i. Array Multiplier (Signed and Unsigned)
  - ii. Booth Multiplier (Radix-4)
3. Write Verilog code for the design of 4/8-bit
  - i. Universal Shift Register
  - ii. Parity Generator
4. Write Verilog code for the design of 4/8-bit
  - i. Pseudo Random Pattern Generator
  - ii. LFSR
5. Design a Mealy and Moore Sequence Detector using Verilog to detect Sequence.  
Eg. 11101 (with and without overlap) any sequence can be specified

Note: (For the experiments listed above, students can make the following flow of study

- RTL synthesis
- creation of power Analysis
- use of I/O constraints)

## **REFERENCE BOOKS/LABORATORY MANUALS:**

1. M. Morris Mano, *Digital Design*, Pearson Education, 5th edition, 2013.
2. Charles H. Roth, *Fundamentals of Logic Design*, Thomson Publications, 5<sup>th</sup> edition, 2004.
3. John F. Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4th Edition, 2008.
4. Stephen Brown and Zvonko Vranesic, *Fundamentals of Digital Logic with VHDL Design*, McGraw Hill, 2<sup>nd</sup> Edition, 2005.

## **SOFTWARE/Tools used:**

CADENCE/SYNOPSYS/MENTOR GRAPHICS/TANNER or any other equivalent Tool  
FPGA/CPLD Boards with Xilinx or any other equivalent

## **ADDITIONAL LEARNING RESOURCES:**

1. <http://www.vlab.co.in>
2. <https://swayam.gov.in>

**IV B. Tech. – I Semester**  
**(19BT70401) EMBEDDED SYSTEMS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on Microcontrollers/Microprocessors and Microcontrollers.

**COURSE DESCRIPTION:** MSP430 Architecture; Instruction Set; Programming; On-Chip Resources; Communication with peripherals; Embedded system design approaches.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze MSP430 Architecture, Instruction Set, Addressing modes to develop programs for various control applications using Assembly and Embedded C.
- CO2: Solve Problems by analyzing MSP430 On Chip Resources such as Timer, Clock System, Low Power Modes/techniques and Interrupt Structure.
- CO3: Realize Mixed Signal Processing and Networking Applications, by analyzing on-Chip Resources such as Comparator, ADC, Temperature Sensor, PWM and Communication Peripherals.
- CO4: Analyze Language, IDE Support, Processor IC & Design Technologies, and System Modeling Techniques to capture behavior of Embedded Prototype using suitable model.

**DETAILED SYLLABUS:**

**UNIT-I: ARCHITECTURE OF MSP430 (09 Periods)**

Embedded Systems – Introduction, MSP430 - Anatomy of microcontroller, Memory, Software, Pin out (MSP430G2553), Functional Block diagram, Memory, CPU, and Memory mapped input and output, Clock generator; Exceptions- Interrupts and Resets.

**UNIT-II: PROGRAMMING MSP430 (09 Periods)**

Development Environment, Aspects of C for Embedded Systems, Assembly Language, Register Organization, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Example programs- Light LEDs, Read input from a switch; Automatic Control-Flashing light by delay, use of subroutines and Functions; Basic Clock System, Interrupts and Low Power Modes.

**UNIT-III: TIMERS AND MIXED SIGNAL SYSTEMS (09 Periods)**

Timers - Watchdog Timer, RTC, Timer A, Measurement in capture mode, PWM generation; Mixed Signal Systems- Comparator A, ADC10 SAADC –Architecture, operation- Single Conversion, Temperature Sensor on ADC10, DTC in ADC10; ADC12 – Comparison with ADC10.

**UNIT-IV: COMMUNICATION PERIPHERALS & PROTOCOLS (09 Periods)**

MSP430 Communication Interfaces- USART,USCI, USI;  
Communication Protocols- SPI, Inter-integrated Circuit Bus, USB, CAN

**UNIT -V: EMBEDDED SYSTEM DESIGN****(09 Periods)**

Processor Technology, IC Technology, Design Technology, Tradeoffs.

Model VS. Language, System Modelling – Data Flow Model, FSM, FSMD, HCFSM, PSM, Concurrent Process Model & implementation.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. John H. Davies, *MSP430 Microcontroller Basics*, Newnes Publications, 1<sup>st</sup> Edition, 2008.
2. Santanu Chattopadhyay, *Embedded System Design*, PHI, 2010.
3. Frank Vahid, Tony D. Givargis, *Embedded System Design – A Unified Hardware/Software Introduction*, John Wiley, January 2006

**REFERENCE BOOKS:**

1. Chris Nagy, *Embedded Systems Design using the TI MSP30 Series*, Newnes Publications, October 2003.
2. JorgeonStaunstrup, Wayne Wolf, *Hardware/Software Co-design Principles and Practice*, Springer 2009.
3. Patrick R Schamont, *A Practical Introduction to Hardware/Software Co-design*, Springer publications, January 2010

**IV B. Tech. – I Semester**  
**(19BT70409) REAL TIME SYSTEMS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Microcontrollers/ Microprocessors and Microcontrollers & Embedded Systems.

**COURSE DESCRIPTION:** Real Time Systems Modeling; Scheduling Approaches ;Multiprocessor and Distributed Scheduling Algorithms; Fault Tolerant Systems; Real Time Operating Systems.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze Real Time System Characterization, Workload and Resource management algorithms and apply suitable techniques to model hard and soft real time systems.
- CO2: Solve scheduling problems and apply suitable techniques in constrained RT systems by Surveying various Real Time scheduling approaches for uniprocessor, Multiprocessor and distributed environments.
- CO3: Evaluate appropriate Fault tolerant techniques and apply them to design fail safe RT systems.
- CO4: Implement Efficient Real Time Systems porting suitable operating system on to hardware by Investigating POSIX standard Kernel structure, services and Kernel objects.

**DETAILED SYLLABUS:**

**UNIT-I: MODELING OF REAL TIME SYSTEMS (09 Periods)**

Hard Vs Soft Real Time Systems, A Reference Model of Real Time Systems- Processors and Resources, Temporal Parameters of Real Time Workload, Periodic Task Model, Precedence Constraints and Data Dependency. Functional Parameters, Resource Parameters of Jobs and Parameters of Resources, Scheduling hierarchy.

**UNIT-II: APPROACHES TO REAL TIME SCHEDULING (09 Periods)**

Clock Driven, Weighted Round Robin, Priority Driven, Dynamic Vs Static Systems, Effective Release Times and Dead Lines, Optimality and Non-optimality of EDF and LST algorithms, Challenges in Validating Timing Constraints in Priority Driven Systems, Offline Vs Online Scheduling.

**UNIT-III: SCHEDULING REAL TIME TASKS IN MULTIPROCESSOR AND DISTRIBUTED SYSTEMS (09 Periods)**

Multiprocessor task allocation, Dynamic allocation of tasks, Fault tolerant scheduling of tasks, Clocks in distributed Real Time Systems, Centralized clock distribution, Distributed clock synchronization.

**UNIT-IV: FAULT TOLERANCE TECHNIQUES (09 Periods)**

Introduction, Failures- Causes, Types, Detection. Fault and Error Containment, Redundancy- Hardware, Software, Time, Integrated Failure Handling.

## **UNIT-V: OPERATING SYSTEMS**

**(09 Periods)**

Overview- Threads and Tasks, the Kernel. Time Services and Scheduling Mechanisms, Basic Operating System Functions- Communication and Synchronization, Event Notification and Software Interrupt Memory Management, I/O and Networking. Processor Reserves and Resource Kernel, Capabilities of Commercial Real Time Operating Systems.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

### **TEXT BOOKS:**

1. Jane W.S. Liu, "*Real Time Systems*", Pearson Education, 1st Edition, 2006.
2. Rajib Mall, "*Real Time Systems-Theory and Practice*", Pearson Education India, 1<sup>st</sup> Edition, Nov.2012.
3. C. M. Krishna, Kang G Shin, "*Real Time Systems*", McGraw-Hill Series, Dec. 1996.

### **REFERENCE BOOKS:**

1. Phillip A. Laplante and Seppo J. Ovaska, "*Real-Time Systems Design and Analysis: Tools for the Practitioner*", Wiley-IEEE Press, 4th edition, Nov. 2011.
2. Hermann Kopetz, "*Real-Time Systems: Design Principles for Distributed Embedded Applications*", Springer; 2nd Edition, 2011.

## IV B. Tech. – I Semester

### (19BT70414) **SYSTEM-ON-CHIP DESIGN AND VERIFICATION**

| Int. | Ext. | Total | L | T | P | C |
|------|------|-------|---|---|---|---|
| 40   | 60   | 100   | 3 | - | - | 3 |

**PRE-REQUISITES:** A Course on VLSI Design.

**COURSE DESCRIPTION:** System on Chip Design (SOC) Process; System level Design Issues; Test Strategies; Macro Design and Verification; Reusable Macros; System on Chip Verification; Communication Architectures for SoCs.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate various SoC Design aspects and issues in low power and high speed Implementations.
- CO2: Analyze the Macro Design Process to solve issues in usage of hard macros and Develop reusable macros for system integration.
- CO3: Analyze verification methods at system level, block level and Hardware/Software Co-verification to reduce the test time.
- CO4: Apply various communication architectures to design energy efficient systems.

#### **DETAILED SYLLABUS:**

##### **UNIT-I: SYSTEM ON CHIP DESIGN PROCESS (08 Periods)**

A canonical SoC Design, SoC Design flow- waterfall vs spiral, top down vs Bottom up. Specification requirement, Types of Specification, System Design process, System level design issues - Soft IP Vs Hard IP, Design for timing closure - Logic design issues, Verification strategy, Onchip buses and interfaces, Design for Low Power, Manufacturing test strategies.

##### **UNIT-II: MACRO DESIGN PROCESS (07 Periods)**

Overview of IP Design, planning and Specification, Macro Design and Verification, Soft Macro Productization, Developing hard macros - Design issues for hard macros, Model Development for Hard Macros. System Integration with reusable Macros.

##### **UNIT-III: SoC VERIFICATION - I (12 Periods)**

Technology Challenges, Verification technology options, Verification methodology, Testbench Creation, Testbench Migration, Verification languages, Verification IP Reuse, Verification approaches, Verification and Device Test, Verification plans, Bluetooth SoC. System level verification – System Design, System Verification. Block level verification – IP Blocks, Block Details of Bluetooth SoC, Lint Checking, Formal Model Checking, Functional Verification/Simulation, Protocol Checking, Directed Random Testing, Code Coverage Analysis

##### **UNIT-IV: SoC Verification - II (12 Periods)**

Hardware/Software Co-verification- HW/SW Co-verification Environment, Emulation, soft or virtual Prototypes, Co-verification, UART Co-verification, Rapid Prototype Systems, Software Testing. Static netlist verification, Physical Verification and Design Signoff, Introduction to VMM (Verification Methodology Manual), OVM(Open Verification Methodology) and UVM (Universal Verification Methodology).



**UNIT-V: DESIGN OF COMMUNICATION ARCHITECTURES FOR SoCs (06 Periods)**

On chip communication architectures, System level analysis for designing communication, Design space exploration, Adaptive communication architectures- Communication architecture tuners. Communication architectures for energy/battery efficient systems. Introduction to bus functional models and bus functional model based verification.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Michael Keating, Pierre Bricaud, "*Reuse Methodology manual for System On A Chip Designs*", Kluwer Academic Publishers, Springer US, 3<sup>rd</sup> Edition, 2007.
2. Prakash Rashinkar, Peter Paterson and Leena Singh, "*SoC Verification Methodology and Techniques*", Kluwer Academic Publishers, Springer US, 2013.
3. A.A. Jerraya, W.Wolf, "*Multiprocessor Systems-on-chips*", M K Publishers, Elsevier Science, 2005.

**REFERENCE BOOKS:**

1. William K. Lam, "*Hardware Design Verification: Simulation and Formal Method based Approaches*", Prentice Hall, 1st Edition, 2005.
2. Farzed Nekoogar, Faranak Nekoogar, "*From ASICs to SOC: A Practical Approach*", China Machine Press, 2006.

**IV B. Tech. – I Semester**  
**(19BT70432) EMBEDDED SYSTEMS LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A Course on Microcontrollers.

**COURSE DESCRIPTION:** Familiarization using IDE – CCS, Energia; Instruction Set usage; GPIO – programming; Watchdog timer; Timer, ADC, Comparator – Programming; Low Power Modes demonstration; PWM generation – Speed Control of DC Motor; Networking MSPs.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze MSP430 Architecture, Instruction Set and Demonstrate Competence in developing programs using Assembly and Embedded C.
- CO2: Solve various Problems using CCS and Energia IDE effectively by evaluating various on-chip resources.
- CO3: Develop programs to realize control applications such as Speed control of DC Motor, Reading Ambient Temperature by investigating various interfacing techniques.
- CO4: Survey usage of MSP430 for Mixed Signal Processing and IOT Applications to establish communication deploying various protocols.
- CO5: Work independently and in teams to solve problems with effective Communication.

**LIST OF EXERCISES/LIST OF EXPERIMENTS:**

*(Minimum Ten Experiments to be done)*

1. Introduction to MSP430 launch pad and Programming Environment.
2. Practice on usage of Instruction Set
3. Read input from switch and Automatic control/flash LED (software delay).
4. Interrupts programming example using GPIO.
5. Configure watchdog timer in watchdog & interval mode.
6. Configure timer block for signal generation (with given frequency).
7. Read Temperature of MSP430 with the help of ADC.
8. Test various Power Down modes in MSP430.
9. Generation of Pulse Width Modulation.
10. Use Comparator to compare the signal threshold level.
11. Speed Control of DC Motor
12. Master slave communication between MSPs using SPI.
13. Networking MSPs using Wi-Fi.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. John H Davies, *MSP430 Microcontrollers Basics*, Newnes Publishers, 1<sup>st</sup> Edition, 2008.
2. C P Ravikumar, *MSP430 Microcontrollers in Embedded System Projects*, Elite Publishing House, 1<sup>st</sup> Edition, 2012.

**SOFTWARE/Tools used:**

Code Composer Studio Version 6, Energia, MSP430 launch pads, Wi-Fi booster pack.

## **MINOR DEGREE IN** **POWER SYSTEMS AND DRIVES**

**Offering Department:** ELECTRICAL AND ELECTRONICS ENGINEERING

**Students of Eligible Branches:** CSE, CSSE, IT, ECE, EIE, ME and CE

### **COURSE STRUCTURE**

| Year & Semester                          | Course Code | Course Title                                   | Contact Periods per week |   |   |       | Credits (C) | Scheme of Examination Max. Marks |            |             |
|------------------------------------------|-------------|------------------------------------------------|--------------------------|---|---|-------|-------------|----------------------------------|------------|-------------|
|                                          |             |                                                | L                        | T | P | Total |             | Int. Marks                       | Ext. Marks | Total Marks |
| III B.Tech. I-Sem<br>(2 Theory + 1 Lab)  | 19BT50212   | Electrical Engineering Materials               | 3                        | - | - | 3     | 3           | 40                               | 60         | 100         |
|                                          | 19BT50213   | Electricity Safety and Practices               | 3                        | - | - | 3     | 3           | 40                               | 60         | 100         |
|                                          | 19BT50214   | Sustainable Energy Resources                   | 3                        | - | - | 3     | 3           | 40                               | 60         | 100         |
|                                          | 19BT50232   | Electrical Workshop Practice                   | -                        | - | 2 | 2     | 1           | 50                               | 50         | 100         |
| III B.Tech. II-Sem<br>(2 Theory + 1 Lab) | 19BT60213   | Principles of Energy Auditing and Conservation | 3                        | - | - | 3     | 3           | 40                               | 60         | 100         |
|                                          | 19BT60214   | Special Machines and their controllers         | 3                        | - | - | 3     | 3           | 40                               | 60         | 100         |
|                                          | 19BT60215   | Utilization of Electrical Energy               | 3                        | - | - | 3     | 3           | 40                               | 60         | 100         |
|                                          | 19BT60234   | Auditing and Conservation Practice lab         | -                        | - | 2 | 2     | 1           | 50                               | 50         | 100         |
| IV B.Tech. I-Sem<br>(1 Theory + 1 Lab)   | 19BT70213   | Power Electronic Converters                    | 3                        | - | - | 3     | 3           | 40                               | 60         | 100         |
|                                          | 19BT70214   | Fundamentals of Electric Vehicles              | 3                        | - | - | 3     | 3           | 40                               | 60         | 100         |
|                                          | 19BT70215   | Protection of Electrical systems               | 3                        | - | - | 3     | 3           | 40                               | 60         | 100         |
|                                          | 19BT70234   | Simulation of Electrical Systems lab           | -                        | - | 2 | 2     | 1           | 50                               | 50         | 100         |

**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

### III B. Tech. – I Semester

#### (19BT50212) ELECTRICAL ENGINEERING MATERIALS

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Basic Electrical and Electronics Engineering.

**COURSE DESCRIPTION:** Dielectric properties of organic and inorganic materials and their required properties; Dielectric properties of insulators in static fields and alternating fields; Breakdown of dielectric materials in presence of high voltages; polymer insulation materials and their behaviour in presence of High voltages; Applications of various dielectric materials in high voltage equipment.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to

- CO1: Understand the dielectric properties of various organic and inorganic materials and their suitability for high voltage applications.
- CO2: Realize the behavior of dielectric materials in the presence of static and in alternating fields.
- CO3: Understand the breakdown mechanism of various dielectric materials in the presence of high voltages.
- CO4: Realize the various polymer type insulation system for high voltage applications and the breakdown mechanism in composite insulation system.
- CO5: Understand the suitability of various dielectric materials for various high voltage equipment.

#### **DETAILED SYLLABUS:**

##### **UNIT-I: CONDUCTING AND SEMICONDUCTOR MATERIALS (07 Periods)**

Ohms law and relaxation time of electrons, Electron scattering and resistivity of metals, thermal conductivity of metals, superconductivity; classification of semiconductors, Energy gap, conductivity in intrinsic semiconductors, Hall Effect and carrier density.

##### **UNIT-II: DIELECTRIC PROPERTIES OF INSULATORS IN STATIC FIELDS AND ALTERNATING FIELDS (08 Periods)**

Dielectric Properties of Insulating Materials, Various Types of Polarization in Dielectrics; Static dielectric constant, Polarization and dielectric constant, Internal fields in solids and liquids, static dielectric constant of solids, spontaneous polarization; Frequency dependency of polarization, Ionic polarization, complex dielectric constant, dipolar relaxation, dielectric losses.

##### **UNIT-III: BREAKDOWN PHENOMENA OF DIELECTRIC MATERIALS (12 Periods)**

**BREAKDOWN IN GASES**— Townsend's theory, Streamer's theory, breakdown in electro negative gases, Paschen's law, time lags of breakdown; insulation co-ordination.

**BREAKDOWN IN SOLID DIELECTRICS**— Thermal breakdown and electro mechanical breakdown, treeing and tracking, Internal discharges.

**BREAKDOWN IN LIQUID DIELECTRICS**— Suspended particle theory and stressed oil volume theory.

**UNIT-IV: POLYMER AND COMPOSITE INSULATING MATERIALS (09 Periods)**

Polymeric Organic Materials, Thermoplastic Polymers, Thermoset Polymers, Polymer Compounds, Polyvinylchloride (PVC), Polyethylene (PE), Epoxy resins; Composite Insulating System—Impregnated Paper as a Composite Insulation System, Insulating Board Materials, Fiber Reinforced Plastics, Breakdown in composite insulators.

**UNIT-V: APPLICATIONS OF INSULATION MATERIALS (09 Periods)**

Applications in Power Transformers, Applications in Rotating Machines, Applications in Circuit Breakers, Applications in Cables, Applications in Power Capacitors, Applications in Electronic Equipment.

**Total Periods: 45**

***Topics for Self-study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. Dekker, Adrianus J. *Electrical Engineering Materials*. Prentice-Hall, 1959.
2. Naidu MS. *High Voltage Engineering*. Tata McGraw-Hill Education; 2013 Jun 16.

**REFERENCE BOOKS:**

1. Arora, Ravindra, and Wolfgang Mosch. *High Voltage And Electrical Insulation Engineering*. Vol. 69. John Wiley & Sons, 2011.

**III B. Tech. – I Semester**  
**(19BT50213) ELECTRICITY SAFETY AND SAFE PRACTICES**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Basic Electrical and Electronics Engineering.

**COURSE DESCRIPTION:** The course deals with the various aspects of potential risk due to electrical shock; safety precautions to be followed while working in hazardous zones; safe practices while handling various electrical equipment and during maintenance; and relevant electrical safety standards and Indian rules and acts.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the Indian electricity rules, regulations and various standards to be maintained for safety of life and equipment.
- CO2: Understand the potential effects of electrical shock and safety measures to protect against such risk.
- CO3: Understand the safety aspects and safe practices to be followed while installing residential, commercial and agricultural appliances.
- CO4: Identify various hazardous working zones and take necessary precautionary measures while working in such areas.
- CO5: Follow safety measures during installation, testing, commissioning and maintenance of electrical equipment/plant.

**DETAILED SYLLABUS:**

**UNIT-I: INDIAN ELECTRICITY RULES AND ACTS (09 Periods)**

OSHA standards of electrical safety, Basic electrical safety rules as per OSHA; Objectives and scope of IE acts and IE rules; Significance of Equipment earthing, Earthing of equipment bodies, structures and non-current carrying metallic parts, earthing of system neutral; Rules regarding first aid and firefighting facility, Electrical safety general requirements as per IE rules.

**UNIT-II: ELECTRICAL SAFETY AND SAFETY MANAGEMENT (10 Periods)**

**ELECTRIC SAFETY:** Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, Protection against electrical hazards and types, Effect of current on human body, Principles of electrical safety and approach to prevent accidents.

**ELECTRIC SHOCKS AND ITS PREVENTION:** Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns.

### **UNIT-III: ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS (08 Periods)**

Introduction—Wiring and fitting; Domestic appliances—water tap giving shock, shock from wet wall, fan firing shock; Multi-storied building, Temporary installations, Agricultural pump installation; Do's and Don'ts for safety in the use of domestic electrical appliances; Principles of safety management in electrical plants.

### **UNIT-IV: ELECTRICAL SAFETY IN HAZARDOUS AREAS (08 Periods)**

Hazardous zones—class 0, 1 and 2; Sparks, flashovers and corona discharge in electrical plants; equipment for hazardous locations; Equipment/Enclosures for hazardous gases and vapours; Classification of Enclosures for hazardous locations; Explosives and provisions of Explosives Act.

### **UNIT-V: SAFETY DURING INSTALLATION, TESTING AND MAINTENANCE (10 Periods)**

**Safety during installations:** Preliminary preparations, preconditions for start of installation work and safe sequence, safety aspects during installations.

**Safety during testing:** Purpose of commissioning checks and tests, equipment tests, high voltage energization tests, performance and acceptance tests, safety aspects during commissioning.

**Safety during maintenance:** Operators safety, Types of safety maintenance, Safety procedures, safety precautions during maintenance, planning of maintenance.

**Total Periods: 45**

**Topics for Self-study are provided in the Lesson Plan**

#### **TEXT BOOK:**

1. S.Rao, Prof. H.L.Saluja, "*Electrical Safety, Fire Safety Engineering and Safety Management*", 2<sup>nd</sup> edition, Khanna Publishers. New Delhi, 2018 Reprint.

#### **REFERENCE BOOK:**

1. Cadick, John, Mary Capelli-Schellpfeffer, and Dennis K. Neitzel. *Electrical safety handbook*. McGraw-Hill Education, 2012.

#### **ADDITIONAL LEARNING RESOURCES:**

##### **Indian Electricity acts:**

1. <https://cercind.gov.in/Act-with-amendment.pdf>
2. [https://www.indiacode.nic.in/handle/123456789/2058?view\\_type=browse&sam\\_handle=123456789/1362](https://www.indiacode.nic.in/handle/123456789/2058?view_type=browse&sam_handle=123456789/1362)

**III B. Tech. – I Semester**  
**(19BT50214) SUSTAINABLE ENERGY RESOURCES**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Basic Electrical and Electronics Engineering

**COURSE DESCRIPTION:** Concepts of non-conventional and hybrid energy systems; Operational modes of Co-generation and their economic benefits.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the impacts of conventional energy resources on environment and realize various measures to minimize the greenhouse gas effects.
- CO2: Understand the generating principles and operational aspects of energy from solar.
- CO3: Understand the generating principles and operational aspects of wind energy conversion technologies.
- CO4: Understand the generating principles and operational aspects of Ocean energy, Biomass and geothermal energy conversion technologies.
- CO5: Assess the energy harnessing methods and develop a hybrid energy and energy storage systems.

**DETAILED SYLLABUS:**

**UNIT-I: ENVIRONMENTAL ASPECTS OF POWER GENERATION FROM CONVENTIONAL SOURCES (07 Periods)**

Impact of conventional sources on Environment; Limitation of fossil fuels – effects of hydro-electric projects – Atmospheric pollution – Green House Gases (GHG) emission from various energy sources and its effects – disposal of nuclear waste— need for renewable energy sources.

**UNIT-II: ENERGY FROM SOLAR (11 Periods)**

Introduction, solar radiation, measurement of solar radiation—pyranometer; solar energy collectors; flat plate collectors— liquid and air (non-porous) types; Focusing type— parabolic & point types; solar photovoltaic system— PV cell and its types, configuration of solar panel, PV system; Applications: solar pump, solar water heater.

**UNIT-III: ENERGY FROM WIND (08 Periods)**

Introduction, power extraction from the wind, Wind turbines— horizontal axis wind turbine—propeller type and vertical axis wind turbine— darrieus rotor type; basic components of wind energy conversion systems, Applications: energy storage, water pumping; environmental impacts.



#### **UNIT-IV: ENERGY FROM OCEAN, BIOMASS AND GEOTHERMAL RESOURCES**

**(11 Periods)**

**Energy from ocean:** Introduction, ocean thermal energy conversion (OTEC): open and closed cycle power plants; tidal energy: schematic diagram of tidal power plant; advantages and disadvantages.

**Energy from Biomass:** Introduction, biomass conversion technologies-direct, thermochemical and biochemical conversions; biogas generation—anaerobic digestion process.

**Geothermal energy:** Introduction, Geothermal resources, geothermal power plants—vapor dominated and liquid dominated; environmental issues.

#### **UNIT-V: COGENERATION AND HYBRID ENERGY SYSTEMS**

**(08 Periods)**

**Cogeneration-** Electricity generating systems, Economic and Environmental benefits. Operational modes of co-generation.

**Hybrid energy systems:** Need for hybrid systems, configuration and coordination, Block diagram approach of Stand-alone PV-wind system, PV-Diesel and Wind-diesel; energy storage systems — ultra capacitors, SMES.

**Total Periods: 45**

***Topics for Self-study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. Rai, G.D., *Non-conventional Energy Sources*, Khanna Publishers, New Delhi, 2017.
2. S.Rao, Dr.B.B.Parulekar, *Energy Technology*, third edition, Khanna publications, 2013.

#### **REFERENCE BOOKS:**

1. J K Kaldellis, *Stand-alone and Hybrid Wind Energy Systems*, Wood head, publishing, 1<sup>st</sup> Edition 2010.
2. David Flin, *Cogeneration: A User's Guide. Renewable energy series*, Vol. 11. IET, 2010.
3. D P Kothari, K C Singal and Rakesh Ranjan, *Renewable Energy Sources and Emerging Technologies*, 2nd Edition, 2012.
4. S N Bhadra, D Kastha and S Banerjee, *Wind Electric Systems*, Oxford Publications, 2nd Edition, 2007
5. C S Solanki, *Solar Photo-voltaics – Fundamentals, Technologies and Applications*, PHI Pvt.,Ltd., 2nd Edition, 2011.
6. R. K. Rajput, *A textbook of power system engineering*, Laxmi publications (P) Ltd, 2016.

**III B.Tech. – I Semester**  
**(19BT50232) ELECTRICAL WORKSHOP PRACTICE**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A course on Basic Electrical and Electronic Engineering

**COURSE DESCRIPTION:** Exercises on assessing of electrical parameters and functionality of electrical apparatus; Design and estimation of electrical systems, and protection system for electrical devices and systems; Troubleshooting of electrical appliances and calibration of measuring instruments.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate the usage of power tools for installation applications and cable laying with relevant accessories.
- CO2: Install panel boards for domestic/industrial applications, design and estimate wiring requirements following the code of conduct.
- CO3: Practice the measurement of electrical quantities using modern day tools and also calibrate the precession of the measuring instruments.
- CO4: Realize the protection equipment used in domestic/industry and practice protection schemes for a particular application.
- CO5: Demonstrate the practice of using various ancillary equipment for electrical appliances and also troubleshoot in the case of malfunctioning of electrical appliances.
- CO6: Work independently or in teams to solve problems with effective communication.

**List of Exercises/List of Experiments:**

*(Minimum **Ten** experiments are to be conducted)*

1. Identification and usage of hand and power tools, PPE for electrical installation applications.
2. Practice of cable laying and termination using conduits, casings, cable joints and its necessary items.
3. Installation and testing of single/three phase distribution boards for domestic/industrial applications.
4. Design and estimation of wiring for a typical house.
5. Measurement of electrical quantities using analog and digital meters.
6. Practice energy meter for measurement of energy and tariff estimation.
7. Calibration of measuring instruments.
8. Operation and testing of Fuse, MCB and Relays.
9. Measurement of equipment to earth resistance and determine the internal leakage currents.
10. Practicing and testing of DOL starter for Induction Motors.
11. Design of Timers for operation of electrical appliances.
12. Troubleshooting of electrical appliances — Fan, Mixer/grinder, Water heater/Iron box.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. <http://www.srisaiuniversity.org/downloads/files/n59b79d6117211.pdf>
2. [https://www.gtu.ac.in/syllabus/NEW\\_Diploma/sem-1/Pdf%20Content%20detailing/3312401Electrical%20&%20Electronic%20Workshop.pdf](https://www.gtu.ac.in/syllabus/NEW_Diploma/sem-1/Pdf%20Content%20detailing/3312401Electrical%20&%20Electronic%20Workshop.pdf)

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.youtube.com/watch?v=ax-KUL17YJ4>
2. <https://www.youtube.com/watch?v=TJpQ3fZIt20>
3. <https://www.youtube.com/watch?v=6RJnsa83xTA>
4. <https://www.youtube.com/watch?v=w2M4tS2OMsU>
5. <https://www.youtube.com/watch?v=DzVJiSQNbew>

**III B. Tech. – II Semester**  
**(19BT60213) PRINCIPLES OF ENERGY AUDITING AND CONSERVATION**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Basic Electrical and Electronics Engineering.

**COURSE DESCRIPTION:** Principles of energy audit, management and conservation; Energy efficient motors, lighting schemes; Energy measuring instruments and significance of energy economics.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Apply the relevant rules, regulations and procedure of energy audit in industries and realize the energy management principles and protocols for effective conservation of energy.

CO2: Analyze performance of energy efficient motors and illumination system by applying the relevant protocols of energy auditing.

CO3: Apply appropriate energy auditing instruments for energy auditing in industries and assess their economic benefits.

CO4: Apply the demand side management techniques and relevant standards for organization of energy conservation awareness programs.

**DETAILED SYLLABUS:**

**UNIT-I: ENERGY AUDIT AND MANAGEMENT PRINCIPLES (10 Periods)**

Energy audit — definitions, concept, types of audit, energy index-cost index, pie charts, Sankey diagrams, load profiles, energy saving potential, energy audit of process industry, building energy audit. IE rules and regulations for energy audit.

Energy management — Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting.

**UNIT-II: ENERGY CONSERVATION PRINCIPLES (08 Periods)**

Energy scenario in India and world; Rules for efficient energy conservation; Technologies for energy conservation; Principles of energy conservation, roles and responsibilities of energy managers and auditors in industries.

**UNIT-III: ENERGY EFFICIENT MOTORS AND LIGHTING (09 Periods)**

**Energy efficient motors** - factors affecting efficiency, loss distribution, constructional details, characteristics, variable speed, variable duty cycle systems.

**Lighting** - Good lighting system, lighting control, lighting energy audit.

**UNIT-IV: ENERGY INSTRUMENTS AND ECONOMIC ANALYSIS (10 Periods)**

Principles of energy instruments— Infrared thermometer, data loggers, thermo-couples, pyrometers, Lux meters, tongue testers, power quality analyzer, and PLC and pic applications.

Principles of Energy Economic Analysis— The time value of money concept. Cash flow models, payback analysis, depreciation—numerical problems.

**UNIT-V: PRINCIPLES OF DEMAND SIDE MANAGEMENT (08 Periods)**

Introduction to DSM, Principles of DSM, benefits of DSM, different techniques of DSM – time of day pricing; Management and organization of energy conservation awareness programs.

**Total Periods: 45**

**Topics for Self-study are provided in the Lesson Plan**

**REFERENCE BOOKS:**

1. W.R. Murphy & G. McKay Butter worth, *Energy management*, Butter worth-Heinemann publications, 2<sup>nd</sup> edition, 2016.
2. Albert Thumann, William J. Younger, *Handbook of energy audits*, Taylor & Francis Ltd, 7<sup>th</sup> edition, 2008.
3. Umesh Rathore, *Energy management*, S.K. Kataria & Sons, 2<sup>nd</sup> edition, 2014.
4. W.C. Turner, Stevedoty, *Energy management hand book*, CRC press, 6<sup>th</sup> edition, 2006.
5. D.P. Sen, K.R. Padiyar, Indrane Sen, M.A. Pai, *Recent Advances in Control and Management of Energy Systems*, Interline Publisher, Bangalore, 1993.
6. Ashok V. Desai, Wiley Eastern, *Energy Demand - Analysis, Management and Conservation Hand book on energy auditing - TERI (Tata Energy Research Institute)*, 2005.
7. Craig B. Smith, Kelly E. Parmenter, *Energy management principles Applications, benefits, Savings*, Elsevier Inc (Pergamon Press), 1<sup>st</sup> edition, 2016.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://beeindia.gov.in/sites/default/files/1Ch3.pdf>
2. <https://www.youtube.com/watch?v=M1zijCmeXJg>
3. <https://www.youtube.com/watch?v=FTpMWXMBSyM>
4. [https://www.youtube.com/watch?v=\\_T1Au\\_P5bnQ](https://www.youtube.com/watch?v=_T1Au_P5bnQ)
5. <https://www.youtube.com/watch?v=ENLzwTVjxms>
6. <https://www.youtube.com/watch?v=7hDyLuFJ0c8>
7. <https://www.youtube.com/watch?v=lkNIuFkzxBk>

**USEFUL WEBSITES:**

1. <https://beeindia.gov.in/news-events/energy-conservation-building-code-rules-2018>
2. <https://beeindia.gov.in/content/energy-auditors>
3. <https://nayaenergy.com/difference-between-energy-audit-and-energy-management/>
4. <https://www.sgsgroup.in/en-gb/sustainability/environment/energy-services/energy-audits-and-management/energy-audit>
5. <https://www.consultivo.in/environment-energy/energy-audit-and-management/>
6. <https://www.teriin.org/energy>
7. <http://jnujprdistance.com/assets/lms/LMS%20JNU/Dual%20Degree%20Courses/PGD+MBA%20%20Energy%20Management/Sem%20III/General%20Aspects%20of%20Energy%20Management%20and%20Energy%20Audit.pdf>

**III B. Tech. – II Semester**  
**(19BT60214) SPECIAL MACHINES AND THEIR CONTROLLERS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** -.

**COURSE DESCRIPTION:** Construction, Working, Types, control operation, characteristics and applications of Stepper Motors, Switched Reluctance Motors, Synchronous Reluctance Motors, Permanent Magnet Brushless DC Motors and Linear Induction Motors.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

CO1: Analyze the open and closed loop operational characteristics of stepper motor and assess its performance under various scenarios.

CO2: Analyse the operational aspects of switched reluctance motor to assess the performance and design the constructional features for sustainability.

CO3: Analyse the operational aspects of synchronous reluctance motor to assess its performance, sustainability and applications.

CO4: Analyse the sensorless and sensor based operation and control aspects of permanent magnet brushless DC motor and assess the performance under diverse scenarios.

CO5: Analyze the operational and control aspects of linear induction motor and assess their performance for special applications.

**DETAILED SYLLABUS:**

**UNIT-I: STEPPER MOTORS (09 Periods)**

Constructional features, types, working principle, torque equation, characteristics, open loop and closed loop control of stepper motor, applications.

**UNIT-II: SWITCHED RELUCTANCE MOTORS (09 Periods)**

Construction details, principle of operation, design of stator and rotor pole arcs, torque equation, characteristics, power converters, torque equations, control of switched reluctance motor and applications.

**UNIT-III: SYNCHRONOUS RELUCTANCE MOTORS (09 Periods)**

Constructional features, Types – Axial and Radial flux motors. Principle of operation, characteristics, phasor diagram, control of SyRM, advantages and applications.

**UNIT-IV: PERMANENT MAGNET BRUSHLESS DC MOTOR (09 Periods)**

Constructional details, principle of operation, types of BLDC motor, sensorless and sensor based control of BLDC motors, torque/speed characteristics and applications.

**UNIT-V: LINEAR INDUCTION MOTOR****(09 Periods)**

Construction, principle of operation– single sided and double-sided LIM, thrust equations, performance equations based on current sheet concept, equivalent circuit, goodness factor, characteristics and applications.

**Total Periods: 45**

***Topics for Self-study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. K. VenkataRatnam, *Special Electrical Machines*, University press, New Delhi, 2009.
2. E.G. Janardhanan, *Special Electrical Machines*, PHI learning private limited, 2014.

**REFERENCE BOOKS:**

1. Takashi Kenjo, *Stepping Motors and their Microprocessor controls*, clarendon press, Oxford, 1984.
2. T.J.E. Miller, *Brushless Permanent Magnet and Reluctance Motor Drives*, clarendon press, Oxford 1989.
3. R. Krishnan, *Switched Reluctance Motor Drives – Modeling, Simulation, analysis, Design and Applications*, CRC press, Special Indian Edition, 2015.

### III B. Tech. –I Semester (19BT60215)UTILIZATION OF ELECTRICAL ENERGY

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Basic Electrical and Electronics Engineering.

**COURSE DESCRIPTION:** Types and characteristics of electric drives; types of electric heating and welding; Fundamentals and various methods of Illumination; electric traction; electrolysis, Extraction and refining of metals.

**COURSE OUTCOMES:** After successful completion of this course, student will be able to:

CO1: Understand the operational aspects of various drives and apply an appropriate electric drives for various industrial applications.

CO2: Understand the different types of heating and welding techniques.

CO3: Design illumination system for proper lighting system under given circumstances.

CO4: Understand the basic principle of traction systems and different braking techniques used in electric traction.

CO5: Understand the basic principle and applications of electrolytic process.

#### **DETAILED SYLLABUS:**

#### **UNIT-I: ELECTRIC DRIVES (08 Periods)**

Type of electric drives – rating and choice of motor - starting and running characteristics - particular applications of electric drives - types of industrial loads - Continuous - intermittent and variable loads.

#### **UNIT-II: ELECTRIC HEATING & WELDING (10 Periods)**

**Introduction** - Advantages and methods of electric heating - resistance heating - induction heating and dielectric heating.

**Electric welding:** Classification- resistance and arc welding - electric welding equipment - comparison between AC and DC Welding.

#### **UNIT-III: ILLUMINATION (10 Periods)**

Introduction - terms used in illumination - laws of illumination - sources of light. Discharge lamps – mercury vapor and sodium vapor lamps – comparison between tungsten filament lamps and fluorescent tubes – compact fluorescent lamp – LED -Basic principles of light control - Types and design of good lighting system and practice - flood lighting.

#### **UNIT-IV: ELECTRIC TRACTION (10 Periods)**

Traction systems: System of electric traction and track electrification - Review of existing electric traction systems in India - Special features of traction motor - Speed-time curves for different services - methods of electric braking - plugging - rheostatic braking, regenerative braking.



**UNIT-V: ELECTROLYTIC PROCESS****(07 Periods)**

Introduction - Basic principles - Faradays laws of electrolysis - Energy efficiency - Electrodeposition-Factors governing deposition Processes - Deposition of Alloys - Extraction and refining of metals.

**Total Periods: 45**

***Topics for Self-study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. C.L Wadhwa, *Generation Distribution and Utilization of Electrical Energy*, New age International Publishers,
2. J. B. Gupta, *Utilization of Electrical Power and Electric Traction*, S. K. Kataria and ons, 2002.

**REFERENCE BOOKS:**

1. N. V. Suryanarayana, *Utilization of Electrical Power including Electric drives and Electric traction*, New Age International (P) Limited, Publishers, 1996.
2. Alan.V. Oppenheim, Ronald.W. Schafer, John R Buck, *Discrete Time Signal Processing*, Prentice Hall, 2<sup>nd</sup> edition, 2006. E.Openshaw Taylor, *Utilization of Electric Energy*, Orient Longman, 1971.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.NPTEL> video lectures.
2. <https://www.opto-e.com/basics/led-pulsing-and-strobing>

**III B. Tech. – II Semester**  
**(19BT60234) AUDITING AND CONSERVATION PRACTICE LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:**

**COURSE DESCRIPTION:** Experimental investigations on behavior of insulators, performance of synchronous and asynchronous machines, relay testing and fault analysis.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate skill in identifying an appropriate auditing tool for measuring appropriate electrical and non-electrical preliminary quantities for auditing.
- CO2: Demonstrate skills to apply the auditing principles for illumination, house hold utilities and suggest a suitable conservation methods for economic benefits.
- CO3: Demonstrate skills to audit various industrial drives and suggest suitable methods for energy conservation adhering the protocols of auditing.
- CO4: Perform auditing by following the auditing protocols in various commercial, agricultural and domestic class of customers and suggest an appropriate energy conservation practices for economical benefits.
- CO5: Work independently or in teams to solve problems with effective communication.

**Practical Exercises/List of Experiments:**

*(Minimum Ten experiments are to be conducted.)*

1. Demonstration of auditing instruments for measuring electrical and non-electrical quantities for auditing purpose.
2. Measurement of active, reactive power and energy for auditing purpose.
3. Assess power quality problems using power quality analyzer and suggest a suitable conservative measures to mitigate.
4. Testing of Electric motor drive for energy conservation.
5. Analyze star labeled electrical apparatus and compare the data sheet of various star ratings.
6. Determine energy consumption by fluorescent/incandescent lamp and evaluate net energy savings and payback period by replacing with energy efficient lamp.
7. Evaluate energy conservation in a ceiling fan with and without an electronic regulator.

8. Conserve the energy consumption in a three phase induction motor by applying an appropriate energy conservation method.
9. Determine the energy conservation in an induction motor operating in star and delta mode of operation.
10. Estimate energy and economic savings by improving power factor for a given class of consumer.
11. Estimate the economic benefits of improving load factor for a domestic consumer.
12. Audit the energy of a commercial consumer and suggest an appropriate energy conservation practice to reduce energy bill.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://sites.google.com/a/venusict.org/energy-conservation-and-management/ntpl-video-links>
2. <https://nptel.ac.in/courses/108/105/108105058/>
3. [https://www.youtube.com/watch?v=Nd\\_EL\\_B3JBQ](https://www.youtube.com/watch?v=Nd_EL_B3JBQ)
4. <https://www.youtube.com/watch?v=lkNIuFkzxBk>
5. <https://www.youtube.com/watch?v=730netBSZKY>
6. [https://www.youtube.com/watch?v=R\\_FdTPbgzTs](https://www.youtube.com/watch?v=R_FdTPbgzTs)

**IV B. Tech. – I Semester**  
**(19BT70213) POWER ELECTRONIC CONVERTERS**

| Int. Marks | Ext. Marks | Total Marks | L | T  | P  | C |
|------------|------------|-------------|---|----|----|---|
| 40         | 60         | 100         | 3 | -- | -- | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Switched mode power supplies; Silicon Controlled Rectifier — with and without isolation, single and multiple outputs; Single phase and three phase topologies; DC-DC converter; AC-AC converter and AC-DC converter; DC-AC converter.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate the knowledge on energy conversion of Switched mode power supplies, Matrix converter and soft switch converters.
- CO2: Analyze closed loop control and regulation of Switched mode dc power supplies based converter.
- CO3: Analyze AC-DC, AC-AC and DC-AC circuit operation and evaluate their output parameters by using different firing pulses.
- CO4: Analyze the Soft switching techniques of AC-DC, DC-DC and DC-AC converter circuits by using ZVS, ZCS and quasi resonance operation.

**DETAILED SYLLABUS:**

**UNIT-I: SWITCHED MODE POWER SUPPLIES (11 Periods)**

DC Power supplies and Classification; Switched mode dc power supplies - with and without isolation, single and multiple outputs; Closed loop control and regulation; Design examples on converter and closed loop performance.

**UNIT-II: AC-DC CONVERTERS (11 Periods)**

Switched mode AC-DC converters. Synchronous rectification - single and three phase topologies - switching techniques - high input power factor . Reduced input current harmonic distortion. improved efficiency with and without input-output isolation; Performance indices design examples.

**UNIT-III: DC-AC CONVERTERS (07 Periods)**

Multi-level Inversion - concept, classification of multilevel inverters, Principle of operation, main features and analysis of Diode clamped, Flying capacitor and cascaded multilevel inverters; Modulation schemes.

**UNIT-IV: AC-AC CONVERTERS WITH AND WITHOUT DC LINK (07 Periods)**

Matrix converters. Basic topology of matrix converter; Commutation – current path; Modulation techniques - scalar modulation, indirect modulation; Matrix converter as only AC-DC converter; AC-AC converter with DC link - topologies and operation - with and without resonance link - converter with dc link converter; Performance comparison with matrix converter with DC link converters.

**UNIT-V: SOFT-SWITCHING POWER CONVERTERS****(09 Periods)**

Elementary principles of Soft switching techniques: ZVS and ZCS; Performance comparison hard switched and soft switched converters— AC-DC converter, DC-DC converter, DC-AC converter; Resonant DC power supplies.

**Total Periods: 45**

***Topics for Self-study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. M.H.Rashid, *Power Electronics Handbook*, Academic press, New york, 2000.
2. Fang Lin Luo and Fang Lin Luo, *Advanced DC/DC Converters*, CRC Press, NewYork, 2004.
3. Marian P.Kazmierkowski, R.Krishnan and Frede Blaabjerg, *Control in Power Electronics- Selected Problem*, Academic Press (Elsevier Science), 2002.

**REFERENCE BOOKS:**

1. Issa Batarseh, *Power Electronic Circuits*, John Wiley and Sons, Inc.2004
2. Frede Blaabjerg and Zhe Chen, *Power Electronics for Modern Wind Turbines*, Morgan & Claypool Publishers series, United States of America, 2006.
3. Krein Philip T, *Elements of Power Electronics*, Oxford University press, 2008
4. Agarwal , *Power Electronics: Converters, Applications, and Design*, 3rd edition, Jai P, Prentice Hall,2000
5. L. Umanand, *Power Electronics: Essentials & Applications*, John Wiley and Sons,2009

**ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/108/102/108102145/>
2. <https://nptel.ac.in/courses/108/101/108101126/>
3. <https://nptel.ac.in/courses/108/101/108101038/>
4. <https://nptel.ac.in/courses/108/107/108107128/>

**IV B. Tech. – I Semester**  
**(19BT70214) FUNDAMENTALS OF ELECTRIC VEHICLES**

| Int. Marks | Ext. Marks | Total Marks | L | T  | P  | C |
|------------|------------|-------------|---|----|----|---|
| 40         | 60         | 100         | 3 | -- | -- | 3 |

**PRE-REQUISITES:** A course on Basic Electrical and Electronics Engineering.

**COURSE DESCRIPTION:** Transportation vehicles and their impact in society; Concept, configurations, principle, types and operation of Electric Vehicles (EV); Power Electronic converters in EVs; Different motor drives & energy storage and management technologies in EVs.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Understand the principle of operation of electric, hybrid-electric vehicles and various emerging technological challenges while confronting the issues during transportation.
- CO2: Analyze the performance characteristics of various power converters operating in different modes to assess a suitable convertor and its control strategies for sustainability of electric vehicle.
- CO3: Analyze various propulsion motor drives operating in different modes for sustainability and to determine their performance/operational parameters of electric vehicle.
- CO4: Analyze various battery energy storage & management systems and assess their adaptability for sustainable performance of electric vehicle.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO EVS AND HEVS (10 Periods)**

Environmental impact and history of modern transportation, , Electric Vehicles (EVs) — configurations, traction motor characteristics; Hybrid Electric Vehicles (HEVs) — concept and architectures; series and parallel HEVs — configuration, operation, advantages and disadvantages; HEVs — interdisciplinary nature, challenges and key technologies; Plug-in EV — concept and architectures.

**UNIT-II: POWER ELECTRONICS IN EVs AND HEVs (08 Periods)**

Power electronics — semiconductor devices and circuits used for control and distribution of electric power, AC-DC, DC-DC, DC-AC conversion, four quadrant operation of converters, Thermal Management of HEV power electronics.

**UNIT-III: ELECTRIC PROPULSION SYSTEM (09 Periods)**

Introduction, configuration and control — DC motor drives, Induction Motor drives, Permanent Magnet Motor drives and Switched Reluctance Motor drives and drive efficiency.

**UNIT-IV: ENERGY STORAGE SYSTEMS****(09 Periods)**

Electrochemical Batteries — terminology, specific energy, specific power, energy efficiency in lead-acid batteries, nickel based batteries, lithium based batteries; Ultra-capacitors — features, principle of operation and performance; High speed fly-wheels — operating principle, power capacity, fly-wheel technologies and hybrid energy storage systems; Fuel cell — principle of operation and performance.

**UNIT-V: ENERGY MANAGEMENT SYSTEM****(09 Periods)**

Energy Management Strategies, Concept of State of Charge (SoC) and State of Health (SoH), EV charging standards, concept of V2G, V2V, V2H — principle of operation (Block diagram approach only). Wireless Power Transfer — principle of operation (Block diagram approach only).

**Total Periods: 45**

***Topics for Self-study are provided in the Lesson Plan***

**TEXT BOOKS:**

1. K. T. Chau, *Electric Vehicle Machines and Drives, Design, Analysis and Application*, Wiley, 2015.
2. John G. Hayes, *Electric Powertrain*, Wiley, 2018.

**REFERENCE BOOKS:**

1. Iqbal Husain, *Electric and Hybrid Vehicles Design Fundamentals*, 2<sup>nd</sup> edition, CRC Press, 2011.
2. Jack Erjavec, *Hybrid, Electric & Fuel-Cell Vehicles*, 2<sup>nd</sup> edition, Delmar Cengage learning, 2013.
3. MehrdadEhsani, Yimin Gao and Ali Emadi, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles*, 2<sup>nd</sup> edition, CRC Press, 2015.
4. Chris Mi, M. AbulMasrur, David WenzhongGao, *Hybrid Electric Vehicles Principles and Applications with Practical Perspectives*, Wiley, 2011.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/108/102/108102121/>
2. [https://swayam.gov.in/nd1\\_noc20\\_ee18/preview](https://swayam.gov.in/nd1_noc20_ee18/preview)
3. <https://www.coursera.org/learn/electric-vehicles-mobility?#syllabus>

**IV B. Tech. – I Semester**  
**(19BT70215) PROTECTION OF ELECTRICAL SYSTEMS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Basic Electrical and Electronics Engineering

**COURSE DESCRIPTION:** Overview of protective schemes; fuses; circuit breakers; electromagnetic relays; protective schemes applied for various components under various operating conditions; different grounding schemes.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the conceptual knowledge of various fuses for secured operation of domestic and industrial appliances.
- CO2: Apply the conceptual knowledge of various circuit breakers for secured operation of power system network.
- CO3: Apply the conceptual knowledge of various relays for secured operation of power system network.
- CO4: Analyze various protection schemes for the protection of alternators, transformers and motors.
- CO5: Apply various neutral grounding methods and determine the system parameters for protection in power system.

**DETAILED SYLLABUS:**

**UNIT-I: FUSES (06 Periods)**

Necessity of power system protection; Types of fuses — low voltage fuse and high voltage fuse; Advantages and disadvantages; Important terms — Current rating of fuse element, fusing current, fusing factor, cut-off current, pre-arcing time, arcing time, breaking capacity; Application of fuse in residential and commercial loads.

**UNIT-II: ELECTRICAL SWITCHGEAR (09 Periods)**

Essential features of switchgear, switchgear components; Phenomenon of arc, arc voltage, recovery voltage, restriking voltage; Types of circuit breakers; Construction and principle of operation — minimum oil circuit breaker, air blast circuit breaker, vacuum circuit breaker and SF<sub>6</sub> circuit breaker, and their comparisons, advantages and disadvantages; Applications of circuit breakers, importance of rating of circuit breakers.

**UNIT-III: PROTECTIVE RELAYS (08 Periods)**

Fundamental requirements of protective relaying, classification of relays — electromagnetic attraction and induction type relays; Construction and working principle of induction type over current relays, differential relays and biased differential relays; Universal torque equation; Characteristics of overcurrent, differential relays; Importance of primary and backup protection, elementary principles of static relays and microprocessor based relays.



#### **UNIT-IV: PROTECTION OF ALTERNATORS, TRANSFORMERS AND MOTORS**

**(11 Periods)**

**Protection of alternators:** Various faults in alternators — failure of prime-mover, failure of field, overcurrent, overvoltage, unbalanced loading, stator winding faults, rotor winding faults; Rotor protection; Stator protection — restricted earth fault protection and internal fault protection.

**Transformer protection:** Internal and external faults; Percentage differential protection, Protection against internal faults – Buchholtz relay.

**Motor protection:** Various faults & abnormal operating conditions, protection in motors, thermal relays and protection of small and large induction motors.

#### **UNIT-V: SUBSTATION PROTECTION**

**(11 periods)**

**Protection of feeders:** Protection of radial and ring main feeders using over current relays.

**Protection against over-voltages:** Causes of over voltages in power systems, protection against lightning over voltages — surge diverters and absorbers; Working and applications of sphere gap, horn gap and valve type of lightning arrestors.

**Neutral grounding:** Necessity of neutral grounding, effects of ungrounded neutral on system performance; Methods of neutral grounding — solid, resistance and reactance grounding—merits and demerits.

**Total Periods: 45**

***Topics for Self-study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. Sunil S. Rao, *Switchgear Protection and Power Systems (Theory, practice and Solved Problems)*, 13<sup>th</sup> edition, Khanna Publishers, New Delhi, 2013.
2. Rohit Mehta and V.K. Mehta, *Principles of Power System*, 24<sup>th</sup> edition, S. Chand Publishing, 2010.

#### **REFERENCE BOOKS:**

1. Badri Ram, D. N. Viswakarma, *Power system Protection and Switchgear*, 2<sup>nd</sup> edition, McGraw Hill education (India) Private Limited, New Delhi, 2011.
2. C. L. Wadhwa, *Electrical Power systems*, 7<sup>th</sup> edition, New Age International (P) Limited, Publishers, New Delhi, 2017.

#### **ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/108/101/108101039/>
2. <https://lsin.panasonic.com/blog/understand-importance-switchgear-protection-devices/>
3. <https://www.eit.edu.au/courses/professional-certificate-of-competency-electrical-power-system-fundamentals/>
4. <https://electrical-engineering-portal.com/download-center/books-and-guides/relays/protection-fundamentals>
5. [https://www.youtube.com/watch?v=LAiBuu\\_nICI](https://www.youtube.com/watch?v=LAiBuu_nICI)

**IV B. Tech. – I Semester**  
**(19BT70234) SIMULATION OF ELECTRICAL SYSTEMS LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A course on Basic Electric and Electronics Engineering.

**COURSE DESCRIPTION:** Investigation of behavior/operational aspects of various electrical systems using simulation tools.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate generation of signals and perform basic operations on the signals
- CO2: Analyze various electric circuits operating under different scenarios.
- CO3: Investigate the time domain specifications of a electrical system and develop a controller to control the dynamics.
- CO4: Determine the operational aspects of various electrical machines
- CO5: Analyze the operation of power electronic circuits for different operating conditions
- CO6: Estimate the tariff for domestic load and also forecast the load from the time series data.
- CO7: Work independently or in teams to solve problems with effective communication.

**Practical Exercises/List of Experiments:**

*(Minimum Ten experiments are to be conducted.)*

1. Generation of continuous and discrete time signals.
2. Basic operations on continuous and discrete time signals — Time scaling and amplitude scaling.
3. Simulate Locus diagram for RL and RC circuits.
4. Determine maximum power transfer using Maximum power transfer theorem.
5. Determine time domain specifications of a transfer function.
6. PID controller for controlling time domain response.
7. Load characteristics of asynchronous machine.
8. Determination of transformer efficiency.
9. Simulation of Single-phase half and full controlled bridge converter with R and RL loads.
10. Simulation of step-down and step-up choppers.
11. Load forecasting using statistical methods.
12. Estimating load consumption and tariff for the domestic load profile.

## **MINOR DEGREE IN**

### **INSTRUMENTATION AND CONTROL ENGINEERING**

**Offering Department:** ELECTRONICS AND INSTRUMENTATION ENGINEERING

**Students of Eligible Branches:** CSE, CSSE, IT, ECE, EEE, ME and CE

#### **COURSE STRUCTURE**

| Year<br>&Semester                             | Course<br>code | Course title                           | Contact Periods<br>per week |   |   | C | Scheme of Examination<br>Max. Marks |               |                |
|-----------------------------------------------|----------------|----------------------------------------|-----------------------------|---|---|---|-------------------------------------|---------------|----------------|
|                                               |                |                                        | L                           | T | P |   | Int.<br>Marks                       | Ext.<br>Marks | Total<br>Marks |
| III B.Tech.<br>I-Sem<br>(2 Theory+<br>1 Lab)  | 19BT31001      | Electrical and Electronic Measurements | 3                           | - | - | 3 | 40                                  | 60            | 100            |
|                                               | 19BT41001      | Industrial Instrumentation             | 3                           | - | - | 3 | 40                                  | 60            | 100            |
|                                               | 19BT71004      | Computer Control of Process            | 3                           | - | - | 3 | 40                                  | 60            | 100            |
|                                               | 19BT41031      | Industrial Instrumentation lab         | -                           | - | 2 | 1 | 50                                  | 50            | 100            |
| III B.Tech.<br>II-Sem<br>(2 Theory+<br>1 Lab) | 19BT71003      | Aircraft Instrumentation               | 3                           | - | - | 3 | 40                                  | 60            | 100            |
|                                               | 19BT61001      | Process Control Instrumentation        | 3                           | - | - | 3 | 40                                  | 60            | 100            |
|                                               | 19BT61005      | Smart Sensors                          | 3                           | - | - | 3 | 40                                  | 60            | 100            |
|                                               | 19BT61031      | Process Control Lab                    | -                           | - | 2 | 1 | 50                                  | 50            | 100            |
| IV B.Tech.<br>I-Sem<br>(1 Theory+<br>1 Lab)   | 19BT71001      | Biomedical Instrumentation             | 3                           | - | - | 3 | 40                                  | 60            | 100            |
|                                               | 19BT71002      | Programmable Logic Controllers         | 3                           | - | - | 3 | 40                                  | 60            | 100            |
|                                               | 19BT71031      | Biomedical Instrumentation Lab         | -                           | - | 2 | 1 | 50                                  | 50            | 100            |

**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

**III B. Tech. – I Semester**  
**(19BT31001) ELECTRICAL AND ELECTRONIC MEASUREMENTS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Science of measurement; construction and principle of operation of ammeters, voltmeters, ohmmeters; potentiometers; power meter; power factor meter; energy meter; design of AC and DC bridges; frequency and time measurements.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Select suitable measuring instrument for measurement of voltage, current, resistance, power and energy by applying the fundamental concepts of measuring instruments.
- CO2: Calibrate the DC and AC potentiometers and apply the concepts for calibration of ammeter & voltmeter and measurement of resistance & inductance.
- CO3: Design AC and DC bridges for measurement of resistance, capacitance and Inductance.
- CO4: Demonstrate the digital measuring instrument used for measurement of frequency and time period.

**DETAILED SYLLABUS:**

**UNIT-I: AMMETERS AND VOLTMETERS**

**(11 Periods)**

Classification of analog instruments, Principle of operation of analog instruments, operating forces of electromechanical indicating instruments: deflecting, control and damping; Permanent Magnet Moving Coil (PMMC): Construction, working principle, Expression of torque equation, Errors in PMMC Instruments, Advantage and Disadvantages of PMMC Instruments; Moving Iron Instruments: Classification of Moving Iron Instruments, Construction, working principle and Expression of torque equation; Ammeter: Ammeter shunt, Effect of Temperature Change in Ammeter, Multi-range Ammeters; Voltmeter: Voltmeter Multipliers, Effect of Temperature Change in Voltmeters, Multi-range Voltmeter Analog voltmeter, AC voltmeter using rectifiers, true RMS Voltmeter

**UNIT-II: OHMMETERS AND POTENTIOMETERS**

**(09 Periods)**

Ohmmeters: Series type ohmmeter, shunt type ohmmeter, Multimeter.

DC Potentiometers: Basic potentiometer circuit, standardization, Compton's Potentiometers, Multiple-range potentiometer, applications: Calibration of Voltmeter, Calibration of Ammeter, Measurement of Resistance.

AC Potentiometers: Standardization, Types of A.C Potentiometers: Polar types, Coordinate types, applications: Voltmeter Calibration, Ammeter Calibration, Measurement of Self reactance of a coil.

### **UNIT-III: POWER & ENERGY METERS**

**(08 Periods)**

Power in D.C Circuits, Power in A.C Circuits, Electrodynamometer wattmeter: Construction, working principle, Torque equation, Errors in Electrodynamometer wattmeter, Three Phase Wattmeter. Electrodynamometer Power Factor Meter: Single Phase, Three Phase. Energy Meter: Single Phase Induction Type Energy Meter: Construction, Working Principle, Errors in Single Phase energy meter; Polyphase energy meters: Two element energy meter

### **UNIT-IV: BRIDGES**

**(08 Periods)**

Measurement of Resistance: Medium Resistance Measurement: Wheatstone bridge, Kelvin Bridge; Low Resistance Measurement: Kelvin double bridge; High Resistance Measurement: Direct deflection methods.

Measurement of Inductance: Maxwell Bridge, Hay's Bridge and Anderson Bridge.

Measurement of capacitance: De Sauty's Bridge and Schering bridge, Q-meter.

### **UNIT-V: FREQUENCY AND TIME MEASUREMENTS**

**(09 Periods)**

Digital Frequency Meter - Basic Circuit, Time Base Selector, Start and Stop gate; Circuit for Measurement of Frequency; Simplified Composite Circuit for a Digital Frequency Meter; High Frequency Measurement, Frequency synthesizer; Period Measurement; Ratio and Multiple Ratio Measurements; Time Interval Measurements; Universal Counter Timer.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

### **TEXT BOOK:**

1. A.K.Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, New Delhi, 19<sup>th</sup> Revised edition, 2013.
2. H S Kalsi, *Electronic Instrumentation and Measurements*, McGraw-Hill, 4<sup>th</sup> edition, 2019.

### **REFERENCE BOOKS:**

1. E.W. Golding & F.C. Widdis, *Electrical Measurements and Measuring Instruments*, 5<sup>th</sup> edition, Wheeler Publishing.
2. Doebelin, E.O., *Measurement Systems: Applications and Design*, McGraw-Hill, 4<sup>th</sup> edition 2003.

### **ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/108/105/108105153/>
2. [https://swayam.gov.in/nd1\\_noc19\\_ee44/preview](https://swayam.gov.in/nd1_noc19_ee44/preview)

**III B. Tech. – I Semester**  
**(19BT41001) INDUSTRIAL INSTRUMENTATION**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Measurement of humidity, Viscosity, Density, Pressure, Level and Flow parameters; Signal Conditioning & Safety Instruments.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze and identify the appropriate transducer to measure density, viscosity, humidity and pressure based on applications.
- CO2: Analyze and identify the appropriate transducer to measure level and flow based on applications.
- CO3: Design signal conditioning circuit for amplifiers, range extension and conversion of V to I & I to V.
- CO4: Demonstrate the safety instruments, requirements for safety and standards.

**DETAILED SYLLABUS:**

**UNIT-I: DENSITY, VISCOSITY & HUMIDITY MEASUREMENT (11 Periods)**

Density: Introduction, Pressure head type, Displace type, Float type, Buoyancy effect densitometer method, Hot-wire gas bridge type, Vibration type, Radioactive method. Viscosity: Introduction, Friction tube viscometer, Saybolt's viscometer, Rotameter viscometer, Searle's rotating cylinder, Cone and Plate viscometer. Consistency meter – Rotating vane type and oscillating type. Humidity: Psychrometer, hygrometer & Types, Dew point device. Analysis and selection of Density, Viscosity and Humidity sensors.

**UNIT-II: PRESSURE MEASUREMENT (08 Periods)**

Dead weight gauges, Manometer and its Types, Elastic transducers – Bourdon tube, Diaphragm, Bellows, Electrical Types, Resistive, Inductive and Capacitive, Force balance & Vibrating Cylinder, High pressure measurement – Very high pressure transducer (Bulk modulus Gage), Low Pressure (Vacuum) measurement – McLeod Gage, Knudsen Gage, Momentum transfer gage, Thermal conductivity gage, Ionization gage, Sound level meter, Microphone. Analysis and selection of pressure sensors.

**UNIT-III: LEVEL MEASUREMENT (07 Periods)**

Introduction, Gauge Glass technique, Float Types – Float-and- tape method, Float-and-shaft method, Magnetic float types. Displacer types, Hydrostatic types – Air-Purge type, Bubbler type. Thermal effect types, Electrical types – Resistance switch type, Inductive and Capacitance type. Ultrasonic Methods, bellow element type level transmitters, Fibre - optic type, Analysis and selection of level sensors.

**UNIT-IV: FLOW MEASUREMENT****(10 Periods)**

Introduction, Head types – Orifice, Venturi, Flow Nozzle, Dahl Tube, Pitot tube, Area Flow meter - Rotameter & types, Mass flow meters – Turbine Mass flow meter, Coriolis flow meter, Gyroscopic flow meter, Liquid bridge mass flow meter, Calorimetric flow meter. Positive Displacement type flow meters - Nutating Disc, Rotary Vane, Lobed Impeller, Reciprocating Piston type, Fluted Rotor. Electrical type flow meter – Turbo magnetic flow meter, Electromagnetic flow meter, Ultrasonic flow meter, Hotwire anemometer type, Vertex Shedding type. Analysis and selection of Flow sensors.

**UNIT-V: SIGNAL CONDITIONING & SAFETY INSTRUMENTS****(09 Periods)**

Wheatstone bridge: Compensation & Sensitivity. Design of I to V, V to I converters, Range conversion of current, voltage, Design application of Instrumentation amplifier, Signal conditioning for Self-generating sensors: Chopper and low drift amplifiers Composite amplifier, charge amplifier and electrometer amplifier.

Proximity Sensors, Limit switches, Electrical & Intrinsic Safety: NEMA types, Fuses & Circuit breakers. Explosion hazards & intrinsic safety – Protection methods, Purging, pressurization, ventilation.

**Total Periods: 45**

**Topics for self-study are provided in the lesson plan**

**TEXT BOOKS:**

1. D. Patranabis, *Principles of Industrial Instrumentation*, TMH, 3rd Edition, 2010.
2. A. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, 19th edition, 2011.

**REFERENCE BOOKS:**

1. Bela G Liptak, *Instrument Engineers' Handbook: Process Measurement and Analysis*, CRC Press - Butterworth Heinemann, 4th Edition, 2003.
2. Ramon Pallás Areny, John G. Webster, *Sensors and Signal Conditioning*, John Wiley and Sons, 2nd Edition, 2000.
3. Ernest Doebelin, Dhanesh Manik, *Measurement Systems*, McGraw-Hill International, 6th Edition, 2011.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/108105064/>
2. [https://nptel.ac.in/content/storage2/nptel\\_data3/html/mhrd/ict/text/108105064/lec1.pdf](https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/108105064/lec1.pdf)
3. <https://www.ibiblio.org/kuphaldt/socratic/sinst/book/liii.pdf>

### III B. Tech. – I Semester (19BT71004) **COMPUTER CONTROL OF PROCESS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

#### **PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Analysis of discrete state variable system identification techniques, direct discrete design techniques, advanced control strategies used in industries, Adaptive Control.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to

- CO1: Demonstrate knowledge on discrete data systems, Z –Transform and modified Z - Transform of Sampled Data system.
- CO2: Design of controllers based on discrete time models are used in Industries.
- CO3: Analyze various control strategies and identify mathematical model for various systems.
- CO4: Assess the information to provide effective solution for real time problems using adaptive control methods.

#### **DETAILED SYLLABUS:**

##### **UNIT-I: DISCRETE STATE-VARIABLE TECHNIQUE (11 Periods)**

State equation of discrete data system with sample and hold, State transition equation, Methods Of computing the state transition matrix, Decomposition of discrete data transfer functions, State Diagrams of discrete data systems, System with zero-order hold, Controllability and observability of linear time invariant discrete data system, Stability tests of discrete-data system.

##### **UNIT-II: SYSTEM IDENTIFICATION (08 Periods)**

System Theory, Mathematical models, Model properties, Structural model representation, System identification procedure. Modified Z – Transform, First order system with time delay.

##### **UNIT-III: DESIGN OF CONTROLLERS (09 Periods)**

Computer control loop, Converting continuous time controller to discrete time domain, Design of controllers based on discrete time model and Dahlin's algorithms. Design of Feed Forward Controller: Block Diagram.

##### **UNIT-IV: ADVANCED PROCESS CONTROL STRATEGIES (09 Periods)**

Cascade Control- Dynamic response, Types, Implementation, Predictive Control- Model based and Multivariable System, Statistical Process Control. Algorithms for Processes with Dead Time – Smith Predictor, Analytical Predictor.



**UNIT-V: ADAPTIVE CONTROL****(08 Periods)**

Self-Tuning Regulators, Adaptive Control Adjustment, Indirect Adaptive Control, Direct Adaptive Control, Model Reference Adaptive Control, Relationship between MRAC and STR, Inertial Control with examples.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. S.K.Singh, *Computer Aided Process Control*, PHI, 2009.
2. Gopal, M., *Digital Control and State Variable Methods*, Tata McGraw Hill, 2003.

**REFERENCE BOOKS:**

1. M. Chidambaram, *Computer Control of Processes*, Narosa Publications, 2nd Edition, 2003.
2. Karel J. Keesman, *System Identification: An Introduction*, Springer, 2011.
3. Pradeep B. Deshpande and Raymond H Ash, *Elements of Computer Process Control with Advanced Applications*, 2nd Edition, Instrument Society of America, 1981.
4. Krishna Kant, *Computer-based Industrial Control*, 2nd Edition, PHI, Delhi, 2010.

**ADDITIONAL LEARNING RESOURCES:**

1. <http://nptel.ac.in/courses/112103174/4>
2. <http://nptel.ac.in/courses/112103174/3>
3. [www.freevideolectures.com /Course/3126/Process-Control-and-Instrumentation](http://www.freevideolectures.com/Course/3126/Process-Control-and-Instrumentation)
4. [www.nptel.ac.in/courses/103105064/](http://www.nptel.ac.in/courses/103105064/)

**III B. Tech. – I Semester**  
**(19BT41031) INDUSTRIAL INSTRUMENTATION LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A course on Industrial Instrumentation

**COURSE DESCRIPTION:** LabVIEW basics; Circuit design and simulation in Multisim; Measurement of Torque, Temperature, Viscosity, Humidity, Pressure, Level and Flow.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Apply the LabVIEW functions in programming.
- CO2: Simulate electrical circuits using Multisim.
- CO3: Analyze the characteristics of measuring instruments by applying the fundamental concepts.
- CO4: Develop PC based data logger systems by interfacing hardware devices like myRIO, ELVIS and required sensors for measurement.
- CO5: Design and solve problems in the measurement of parameters for required specifications.
- CO6: Work independently and in teams to solve problems with effective communication.

**LIST OF EXPERIMENTS:**

*(Minimum ELEVEN experiments are to be conducted)*

1. LabVIEW Basics : Practice of Virtual Instrumentation Course content  
Numeric, Boolean, Strings, For, While, Case Structures, Arrays, Clusters, Sequence: Flat, Stacked, Formula Node, SubVI's, Local/Global Variables.
2. Data Acquisition and analysis using Graphs, Charts, myRio/ELVIS and LabVIEW.
3. Data Logging and analysis of simulated or acquired signals using File I/O.
4. Design and verification of converters using op-amps in Multisim.
  - a) I to V
  - b) V to I
5. Design and verification of resistance measurement, conversion in Multisim using
  - a) Op-Amp
  - b) Wheatstone bridge for improving sensitivity, compensation and linearity.
6. Measurement of Pressure.
7. Measurement of Humidity.
8. Measurement of Flow.
9. Measurement of Torque.
10. Measurement of Viscosity.
11. Design and verification of level measurement.
12. Design and verification of Speed measurement.
13. Design and verification of temperature measurement using LabVIEW & ELVIS.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Travis Jeffrey, Jim Kring, *LabVIEW for Everyone*, Pearson Education, 2009.
2. Johnson Jennings, *LabVIEW Graphical Programming*, McGraw Hill, 4<sup>th</sup> Edition, 2014.
3. D. Roy Chowdhury, *Linear Integrated Circuits*, New Age International Pvt. Ltd., 4th Edition, 2010.
4. D. Patranabis, *Principles of Industrial Instrumentation*, TMH, 3rd Edition, 2010.
5. Ramon PallásAreny, John G. Webster, *Sensors and Signal Conditioning*, John Wiley and Sons, 2nd Edition, 2000.
6. A. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, 19th edition, 2011.

**SOFTWARE/Tools used:**

1. NI Labview 2018
2. NI Circuit Design Suite – Multisim 2019
3. NI myRIO
4. NI ELVIS

**ADDITIONAL LEARNING RESOURCES:**

1. <https://www.ni.com/pdf/manuals/320999e.pdf>
2. <https://ieeexplore.ieee.org/document/8960023/>  
A Different way of Level measurement for PBL in Education of Students using NI-LabVIEW, Multisim and MyRIO
3. <http://www.ni.com/pdf/manuals/376047c.pdf>
4. [https://www.clemson.edu/cecas/departments/ece/document\\_resource/undergrad/lab\\_manuals/NI\\_ELIVS\\_II\\_Orientation\\_Manual.pdf](https://www.clemson.edu/cecas/departments/ece/document_resource/undergrad/lab_manuals/NI_ELIVS_II_Orientation_Manual.pdf)
5. <http://www.ni.com/pdf/manuals/374629c.pdf>
6. <http://www.ni.com/pdf/manuals/373363f.pdf>

**III B. Tech. – II Semester**  
**(19BT71003) AIRCRAFT INSTRUMENTATION**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Aircraft Instruments; Air Data Instruments; Gyroscopic Instruments; Engine Instruments and Flight Control and Navigational Aids, EFIS, Electronic warfare and Aircraft safety.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Demonstrate knowledge on aircraft system.
- CO2: Select suitable instrument for specific parameter measurement in an aircraft.
- CO3: Design control schemes for Auto pilot and Auto-throttle system in an aircraft.
- CO4: Select navigation aids for appropriate communication in an aircraft.
- CO5: Demonstrate knowledge on aircraft safety systems and electronic warfare.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO AIRCRAFT (10 Periods)**

Control Surfaces, Forces, Moments and Angle of Attack, Modern Aircraft System, Aircraft Instruments and their Layout, Aircraft Display Types: Quantitative Displays, Display Color and Markings, Glass Cockpits of Modern Aircraft: Attitude Director Indicator, Electronic Attitude Director Indicator, Horizontal Situation Indicator, EFIS, Command bars, HSI, ADP.

**UNIT-II: COCKPIT INSTRUMENTS (10 Periods)**

Introduction to Air Data Instruments, Air Data Computer, Combined Pitot and Static Probe, Position Error, ASI, ALTI, VSI, Introduction to Gyro, Vibrating Gyros, Ring Laser Gyroscope, Fibre Optic Gyros, Directional Gyro, Gyro Horizon.

**UNIT-III: ENGINE INSTRUMENTS (10 Periods)**

Introduction, Engine Speed Measurement: Electrical TachoGenerator/Indicator, Non-Contact type TachoProbe, Torque Measurement, Electronic Torque Meter, Pressure Measurement, Engine vibration Measurement and Monitoring, Fuel Flow Rate Indicator, Engine Fuel Quantity Indicator

**UNIT-IV: FLIGHT CONTROL AND NAVIGATIONAL AIDS****(08 Periods)**

Introduction to AFCS, Auto pilot, Auto-throttle, IFCS, Fundamentals of Radio Navigation Aids, VOR, DME, Instrument Landing system, GPS.

**UNIT-V: ELECTRONIC WARFARE AND AIRCRAFT SAFETY****(07 Periods)**

Introduction to Electronic warfare, Electronic support, EP, EA, Jamming and Spoofing, DEW, Air data warning systems, Stall warning systems, GPWS, TCAS

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOK:**

1. S.Nagabhushana, L.K.Sudha, *Aircraft Instrumentation and Systems*, I K International Publishing House Pvt. Ltd, 2010

**REFERENCE BOOK:**

1. Pallett, E.H.J, *Aircraft Instruments and Integrated Systems*, Pearson higher Education, 1992.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in/courses/101/104/101104069/>
2. <https://nptel.ac.in/courses/112/103/112103281/>
3. <http://www.nptelvideos.in/2012/11/space-flight-mechanics.html>

**III B. Tech. – II Semester**  
**(19BT61001) PROCESS CONTROL INSTRUMENTATION**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Mathematical modeling of processes, Different types of controllers, characteristics of controllers, design of controllers, Tuning of controllers, characteristics of control valves, multi loop controllers.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Develop mathematical model of various process by applying fundamental laws.
- CO2: Design controller by applying fundamental concepts of control schemes and tuning methods.
- CO3: Demonstrate knowledge on various final control elements used in process Industries
- CO4: Apply the Multi loop control concepts of real time industrial and domestic applications.

**DETAILED SYLLABUS:**

**UNIT-I: PROCESS CHARACTERISTICS (10 Periods)**

Elements of process control, Process variables, Degree of freedom, Characteristics of electric system, liquid system, gas system and thermal system, Elements of process dynamics, Mathematical model of liquid process, gas process and thermal processes, Servo operation, Regulatory operation, Self-regulation.

**UNIT-II: CONTROL SCHEMES AND CONTROLLERS (10 Periods)**

Discontinuous controller modes: Two position, Multi-position, Floating control modes; Continuous controller modes: Proportional, Integral, Derivative; Composite controller modes: PI, PD, PID; Electronic controllers: Design of discontinuous, continuous and composite controller modes. Pneumatic controllers (displacement type).

**UNIT-III: CONTROLLER TUNING (08 Periods)**

One-Quarter decay ratio criteria, Time integral performance criteria, Process loop tuning: open-loop transient response method, Ziegler-Nichol's method, Cohen- Coon method, Direct synthesis method, Frequency response method.

**UNIT-IV: FINAL CONTROL ELEMENTS****(09 Periods)**

Pneumatic actuators: Spring actuator, Hydraulic actuators: Piston actuator, Electrical actuators: Solenoid, Electro-pneumatic actuators, Control valves: Types of control valves and its characteristics, Sliding-stem control valves, Rotating-shaft control valves, Selection of control valves, Control-valve sizing, Pneumatic valve positioner.

**UNIT-V: MULTI LOOP CONTROL SCHEMES****(08 Periods)**

Cascade control, Ratio control, Feed forward control, Over-ride, Split range, Case study on distillation column: Principle control scheme- constant top product, constant bottom product and reflux rate, constant reflux rate and steam rate.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. Donald P. Eckman, *Automatic Process Control*, Wiley Eastern Ltd., 1993.
2. Curtis D. Johnson, *Process Control Instrumentation Technology*, Pearson Education, New Delhi, 7<sup>th</sup> Edition, 2002.
3. G. Stephanopoulos, *Chemical Process Control*, Prentice Hall, 1990.

**REFERENCE BOOKS:**

1. Patranabis, *Principles of Process Control*, TMH., 1981.
2. Peter Harriot, *Process Control*, TMH.
3. K. Krishnaswamy, *Process Control*, New Age International, 2<sup>nd</sup> Edition, 2009.

**ADDITIONAL LEARNING RESOURCES:**

1. <https://nptel.ac.in>
2. <https://www.amtekcompany.com> > Amatrol
3. <https://wiki.metakgp.org> > H31011:Instrumentation and Process Control

**III B. Tech. – II Semester**  
**(19BT61005) SMART SENSORS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Smart sensors for physical variables, Different smart materials and technologies, getting sensor information to MCU, Communication protocols and different standards for smart sensors.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Apply suitable smart sensor for measurement of physical parameters.
- CO2. Demonstrate knowledge on smart materials and its fabrication techniques.
- CO3. Design signal conditioning circuits for various smart sensors.
- CO4. Select appropriate protocol for real time applications.
- CO5. Demonstrate knowledge on IEEE standards for smart sensors.

**DETAILED SYLLABUS:**

**UNIT-I: SMART SENSORS FOR ELECTRICAL AND NON-ELECTRICAL, PHYSICAL AND CHEMICAL VARIABLES: TENDENCIES AND PERSPECTIVES (08 Periods)**

Introduction, Temperature IC and Smart Sensors, Pressure IC and Smart Sensors and Accelerometers, Rotation Speed Sensors, Intelligent Opto Sensors, Humidity Frequency Output Sensors, Chemical and Gas Smart Sensors.

**UNIT-II: MATERIALS AND TECHNOLOGIES (09 Periods)**

Materials: Silicon as a Sensing Material, Plastics, Metals, Ceramics, Structural Glasses, Optical Glasses, Nano-materials, Surface Processing: Spin-Casting, Vacuum Deposition, Sputtering, Chemical Vapor Deposition, Electroplating, MEMS Technologies: Photolithography, Silicon Micromachining, Micromachining of Bridges and Cantilevers, Wafer Bonding.

**UNIT-III: GETTING SENSOR INFORMATION INTO THE MCU (10 Periods)**

Introduction, Amplification and Signal Conditioning: Instrumentation Amplifiers, SLEEP MODE Operational Amplifier, Rail-to-Rail Operational Simplifiers, Switched-Capacitor Amplifier, 4- to 20-mA Signal Transmitter, Inherent Power-Supply Rejection, Separate Versus Integrated Signal Conditioning: Integrated Passive



Elements, Integrated Active Elements, Digital Conversion: A/D Converters, Performance of A/D Converters, Implications of A/D Accuracy and Errors.

#### **UNIT-IV: COMMUNICATIONS FOR SMART SENSORS (09 Periods)**

Introduction, Sources (Organizations) and Standards, Automotive Protocols: CAN Protocol, LIN Protocol, Media Oriented Systems Transport, FlexRay, Industrial Networks, Protocols in Silicon: MCU with Integrated CAN, LIN Implementation, Ethernet Controller, Transitioning Between Protocols, Application Example.

#### **UNIT-V: STANDARDS FOR SMART SENSING (09 Periods)**

Introduction, Setting the Standards for Smart Sensors and Systems, IEEE 1451.1, IEEE 1451.2, IEEE 1451.3, IEEE 1451.4, IEEE 1451.5, IEEE 1451.6, IEEE 1451.7, Application Example.

**Total Periods: 45**

***Topics for Self-Study are provided in the Lesson Plan***

#### **TEXT BOOKS:**

1. Nikolay Kirianaki, Sergey Yurish, Nestor Shpak, Vadim Deynaga , "*Data Acquisition and Signal Processing for Smart Sensors*", John Wiley & Sons Ltd, 1<sup>st</sup> edition, 2002.
2. Jacob Fraden , "*Handbook of Modern Sensors: Physics, Designs, And Applications*", Springer, 5<sup>th</sup> edition, 2016.
3. Randy Frank, "*Understanding Smart Sensors*", Artech House, 3<sup>rd</sup> Edition, 2013.

#### **REFERENCE BOOKS:**

1. Sergio Franco, "*Design with Operational Amplifiers and Analog Integrated Circuits*", McGraw-Hill Education, 4<sup>th</sup> edition, 2015.
2. G.K. Ananthasuresh K.J. Vinoy S. Gopala krishnan K.N. Bhat V.K. Aatre, "*Micro and Smart Systems: Technology and Modeling*", John Wiley & Sons, Inc., 1<sup>st</sup> edition, 2012.

#### **ADDITIONAL LEARNING RESOURCES:**

##### **1. Smart sensors:**

[https://www.electrochem.org/dl/interface/wtr/wtr10/wtr10\\_p029-034.pdf](https://www.electrochem.org/dl/interface/wtr/wtr10/wtr10_p029-034.pdf)

[https://www.ee.iitb.ac.in/~esgroup/es\\_mtech02\\_sem/es02\\_sem\\_rep\\_dubey.pdf](https://www.ee.iitb.ac.in/~esgroup/es_mtech02_sem/es02_sem_rep_dubey.pdf)

##### **2. MEMS Technologies: Photolithography**

[https://nanoscale.unl.edu/pdf/Photolithography\\_Participant\\_Guide.pdf](https://nanoscale.unl.edu/pdf/Photolithography_Participant_Guide.pdf)

##### **3. Standards for smart sensors- ieee-1451:**

<https://www.electronicdesign.com/technologies/components/article/21787128/smart-sensors-ieee-1451>.

**III B. Tech. – II Semester**  
**(19BT61031)PROCESS CONTROL LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES:** A course on Process Control Instrumentation.

**COURSE DESCRIPTION:** Tuning methods, Characteristics of control valve, Response of controllers for different processes like flow, level, pressure etc., Design of controllers.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to

- CO1. Demonstrate knowledge on process equipments.
- CO2. Develop the transfer function of the process and analyze the performance of the process in terms of time domain specifications.
- CO3. Design electronic PID controller and tune its controller parameters using various tuning methods.
- CO4. Analyze the response of flow, level and pressure process.
- CO5. Work independently and in teams to solve problems with effective communication.

**LIST OF EXPERIMENTS:**

*(Minimum 10 experiments to be conducted)*

1. Analyze the behavior of Flow process with and without controller.
2. Obtain the performance for liquid level process with and without controller.
3. Response of Pressure Process using controller.
4. Obtain the transfer function model for Interacting Systems.
5. Obtain the transfer function model for Non-Interacting Systems.
6. Analyze the servo and regulatory response for pressure control process.
7. Obtain the characteristics of electro-pneumatic converter.
8. Obtain the controller parameters using Process reaction curve method.
9. Obtain the controller parameters using continuous oscillation method.
10. Study the response of ratio controller.
11. Study the closed loop performance of cascade controller.

12. Obtain the valve flow-lift characteristics of Linear, On-OFF and equal percentage control valve.
13. Realization of control actions- Electronic PID controller.

**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Donald P. Eckman, *Automatic Process Control*, Wiley Eastern Ltd., 1993.
2. Curtis D. Johnson, *Process Control Instrumentation Technology*, Pearson Education, New Delhi, 7<sup>th</sup> Edition, 2002.

**ADDITIONAL LEARNING RESOURCES:**

1. [http://www.vlab.co.in/lab\\_ready\\_for\\_use.php](http://www.vlab.co.in/lab_ready_for_use.php)
2. <https://www.pidlab.com/en/>
3. <http://www.eiecouncil.com/process-control-lab.html>

**IV B. Tech. – I Semester**  
**(19BT71001)BIOMEDICAL INSTRUMENTATION**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Human Anatomy & Physiology; Bio-signals; Cardiovascular and Neuro-muscular Instrumentation; Therapeutic Equipment; Advanced Imaging techniques.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to

- CO1. Demonstrate knowledge on Bioelectric Potentials and various electrodes for measuring Potentials.
- CO2. Analyze ECG signals and measure various cardiovascular parameters.
- CO3. Analyze EEG and EMG signals and measure various parameters in neuro muscular and respiratory systems.
- CO4. Demonstrate the working of various therapeutic instruments.
- CO5. Demonstrate the working of imaging instruments used for diagnosis by following ethical values.

**UNIT-I: BIO ELECTRIC POTENTIALS AND ELECTRODES (09 Periods)**

Block diagram of biomedical instrumentation, Problems encountered in measuring a living system, system, Structure of cell, Resting and Action Potentials, Propagation of Action Potentials, sources of Bioelectric Potentials, Electrode theory, Bio potential electrodes, Bio chemical transducers.

**UNIT-II: CARDIOVASCULAR INSTRUMENTATION (09 Periods)**

Physiology of cardiovascular system, electrical conduction system of the heart, interpretation of ECG waveform, standard 12-lead configurations, Einthoven triangle, specifications of ECG Machine; Blood pressure, blood flow and heart sound measurements; Relation between electrical and mechanical activities of the heart.

**UNIT-III: NEURO-MUSCULAR AND RESPIRATORY INSTRUMENTATION (09 Periods)**

Physiology of nervous system, electrode placement for EEG and EMG recording, Specification of EEG and EMG machines, Interpretation of EEG and EMG.

Respiratory Instrumentation: Mechanism of respiration, Spirometry, Pneumotachograph Ventilators.

#### **UNIT – IV: THERAPEUTIC EQUIPMENT**

**(09 Periods)**

Pacemakers: Need for Cardiac pacemakers, pacing modes, Ventricular asynchronous Pacemaker (Fixed rate Pacemaker), Ventricular inhibited Pacemaker (demand Pacemaker), Atrial Synchronous pacemaker, Comparison between internal & external Pacemakers; Defibrillators: AC Defibrillator, DC Defibrillator, Synchronised DC Defibrillator; Diathermy: Shortwave and microwave, Dialysis: Hemo Dialysis, Peritoneal Dialysis.

#### **UNIT – V: MEDICAL IMAGING SYSTEM**

**(09 Periods)**

Ultrasonic Imaging: Doppler principle, Modes of Display: A-Mode, B-Mode and Echocardiography. Computed Tomography: Block diagram of CT scanner, Applications of Computed Tomography. MRI Imaging System, Cine angiogram, Endoscope.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

#### **TEXTBOOKS:**

1. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "*Biomedical Instrumentation and Measurements*", 2nd Edition, PHI, 2003.
2. R.S. Khandpur, "*Hand Book of Biomedical Instrumentation*", Tata McGraw Hill, 2nd Edition, 2002.

#### **REFERENCE BOOKS:**

1. John G. Webster, "*Medical Instrumentation Application and Design*", 3<sup>rd</sup> Edition, Wiley India Pvt. Ltd., 2004
2. M. Arumugam, "*Biomedical Instrumentation*", Anuradha Publications, 1992.

#### **ADDITIONAL LEARNING RESOURCES:**

1. <https://www.nibib.nih.gov/science-education/students-resource>
2. [https://www.who.int/medical\\_devices/support](https://www.who.int/medical_devices/support)
3. <https://nptel.ac.in>

## IV B. Tech. – I Semester

### (19BT71002)PROGRAMMABLE LOGIC CONTROLLERS

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

#### PRE-REQUISITES: -

**COURSE DESCRIPTION** Introduction to PLC, PLC ladder diagrams, programming PLC, timers, counters and sequences used in PLC, data handling functions, bit Patterns, advanced PLC functions.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate knowledge on programmable logic controllers, various functions of PLCs.
- CO2. Analyse the process of automation using PLC functions.
- CO3. Develop programs for industrial applications to automate the process using PLC functions.
- CO4. Solve real time problems in industries using PLCs.

#### DETAILED SYLLABUS:

##### UNIT-I:PLC BASICS AND PROGRAMMING (09 Periods)

Introduction, PLC advantages, disadvantages, PLC system, CPU,I/O modules and interfacing, power supplies, Programming equipment, Programming formats, Construction of PLC ladder diagrams, Devices connected to I/O modules. Input instructions, outputs, Operational procedures, Programming examples using contacts and coils, Fail-Safe Circuits, Drill press operation.

##### UNIT-II: LADDER DIAGRAMS, REGISTERS AND TIMER FUNCTIONS (09 Periods)

Digital logic gates, Boolean algebra PLC programming, Conversion examples. Ladder Diagrams for process control: Ladder diagrams & sequence listings, ladder diagram construction and flowchart for spray process system. Characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers. Timer function & Industrial applications, Counter functions& industrial applications.

##### UNIT-III: INTERMEDIATE AND DATA HANDLING FUNCTIONS (09 Periods)

Intermediate functions: Arithmetic functions, Number comparison functions, Number conversion functions. Skip, Master control relay, Jump functions. PLC data move systems: Move function, FIFO, FAL, & Sweep functions and their applications.

**UNIT-IV: PLC FUNCTIONS WORKING WITH BITS****(08 Periods)**

Bit Pattern, Changing a register bit status, Shift register functions and applications, Sequencer functions and applications, Controlling of two-axis & three axis Robots with PLC, Matrix functions.

**UNIT-V: ADVANCED PLC FUNCTIONS****(10 Periods)**

Analog modules & systems, Analog signal processing, Multi-bit Data Processing, Analog output application examples, PID principle, position indicator with PID control, PID Modules, PID tuning, PID functions, Networking of PLCs, Alternative Programming languages.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOK:**

1. John W. Webb & Ronald A. Reiss, *Programmable Logic Controllers Principles and Applications*, 5<sup>th</sup> edition, PHI 2009.

**REFERENCE BOOKS:**

1. Frank D. Petruzella, *Programmable Logic Controller*, 3<sup>rd</sup> edition, Tata Mc-Graw Hill, 2010.
2. M.Chidambaram, *Computer Control of Process*, Narosa 2003.

**ADDITIONAL LEARNING RESOURCES**

1. <https://openautomationsoftware.com/use-cases/allenbradleywplscada/>
2. <https://new.siemens.com/global/en/products/automation/industrysoftware/automationsoftware/scada.html>
3. <https://ab.rockwellautomation.com/Programmable-Controllers>

**IV B. Tech. – I Semester**  
**(19BT71031) BIOMEDICAL INSTRUMENTATION LAB**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 50         | 50         | 100         | - | - | 2 | 1 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Measurements of parameters: pH, Dissolved Oxygen, Conductivity blood pressure, respiration rate and heart sounds; Analysis of Bio-Signals; Compression of Bio-Signals.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Select suitable biomedical instrument for specific measurement of physiological parameters.
- CO2. Design signal conditioning circuit for various biosensors.
- CO3. Analyze the response of various biosignals to detect abnormalities.
- CO5. Work independently and in teams to solve problems with effective communication.

**LIST OF EXPERIMENTS:**

**Minimum of TEN experiments to be conducted**

1. Calibration and measurement of pH value, Dissolved Oxygen and Thermal Conductivity of a given sample.
2. Blood pressure measurement.
3. Analysis of ECG for different lead configurations.
4. Analysis of EEG Signals.
5. Analysis of EMG Signals.
6. Design of Instrumentation Amplifier for bioelectrical Signals.
7. Measurement of Heart Sounds.
8. Real time EPR System.
9. Electrical Safety analyzer for biomedical equipments.
10. Analysis of Bio-Signals using Lab View.
11. Compression of Bio-Signals using Lab View.
12. Flame photometer for biomedical applications.
13. Study and analyze the performance of UV-VIS Spectrophotometer.



**REFERENCE BOOKS/LABORATORY MANUALS:**

1. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "*Biomedical Instrumentation and Measurements*", 2nd Edition, PHI, 2003.
2. R.S. Khandpur, "*Hand Book of Biomedical Instrumentation*", Tata McGraw Hill, 2nd Edition, 2002.
3. John G. Webster, "*Medical Instrumentation Application and Design*", 3<sup>rd</sup> Edition, Wiley India Pvt. Ltd., 2004

**ADDITIONAL LEARNING RESOURCES:**

1. Lab view 2013 biomedical toolkit.
2. <http://www.vlab.co.in/ba-nptel-labs-biotechnology-and-biomedical-engineering>
3. <https://physionet.org/>

## **MINOR DEGREE IN ROBOTICS**

**Offering Department:** MECHANICAL ENGINEERING

**Students of Eligible Branches:** CSE, CSSE, IT, ECE, EEE, EIE and CE

### **COURSE STRUCTURE**

| Semester                            | Course Code | Course Title                         | Contact Periods per week |   |   |       | Credits | Scheme of Examination Max. Marks |            |             |
|-------------------------------------|-------------|--------------------------------------|--------------------------|---|---|-------|---------|----------------------------------|------------|-------------|
|                                     |             |                                      | L                        | T | P | Total |         | Int. Marks                       | Ext. Marks | Total Marks |
| III B.Tech.<br>I-Sem<br>(2 Theory)  | 19BT50316   | Computer Integrated Manufacturing    | 3                        | - | - | 3     | 3       | 40                               | 60         | 100         |
|                                     | 19BT50317   | CNC Programming                      | 3                        | - | - | 3     | 3       | 40                               | 60         | 100         |
|                                     | 19BT50318   | Introduction to Mechanical systems * | 3                        | - | - | 3     | 3       | 40                               | 60         | 100         |
| III B.Tech.<br>II-Sem<br>(2 Theory) | 19BT60321   | Principles of Industrial Automation  | 3                        | - | - | 3     | 3       | 40                               | 60         | 100         |
|                                     | 19BT60322   | Principles of Robotics*              | 3                        | - | - | 3     | 3       | 40                               | 60         | 100         |
|                                     | 19BT60323   | Robot Kinematics and Dynamics        | 3                        | - | - | 3     | 3       | 40                               | 60         | 100         |
| IV B.Tech.<br>I-Sem<br>(2 Theory)   | 19BT70315   | Applied and Industrial Robotics      | 3                        | - | - | 3     | 3       | 40                               | 60         | 100         |
|                                     | 19BT70316   | Robotic Programming                  | 3                        | - | - | 3     | 3       | 40                               | 60         | 100         |
|                                     | 19BT70317   | Sensors and Machine Vision Systems   | 3                        | - | - | 3     | 3       | 40                               | 60         | 100         |

\*Compulsory Course if not studied in Major Degree

**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

**III B. Tech. – I Semester**  
**(19BT50316) COMPUTER INTEGRATED MANUFACTURING**

|            |           |            |   |   |   |   |
|------------|-----------|------------|---|---|---|---|
| Int. Marks | Ext.Marks | TotalMarks | L | T | P | C |
| 40         | 60        | 100        | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to CIM, CAD/CAM, product life cycle, Fundamentals of NC and CNC, Group Technology and FMS, Computer Aided Planning Systems, Adaptive control systems

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Apply the principles of Computer integrated manufacturing to control and foster the production process.
- CO2. Analyze the architecture of numerical control and apply the Numerical control programming techniques for machining process.
- CO3. Analyze different part families through grouping and construe different machine cell designs and flexible manufacturing systems.
- CO4. Demonstrate different approaches and techniques for computer aided process planning in automation.
- CO5. Demonstrate the knowledge on Adaptive control systems for different applications.

**DETAILED SYLLABUS:**

**UNIT - I: FUNDAMENTALS OF CIM (09 Periods)**

Introduction to Manufacturing; CIM -Types, Manufacturing Systems, CIM Definition, CIM wheel, CIM components, Evolution of CIM - Development of computers, needs of CIM, Benefits of CIM, CIM Hardware & Software, Fundamentals of CAD / CAM, Product cycle.

**UNIT-II: FUNDAMENTALS OF NC AND CNC (09 Periods)**

**Numerical control machines:** Introduction, basic components of an NC system, the NC procedure, NC coordinate system, NC motion control system, application of numerical control and Economics of Numerical control.

**Computer controls in NC:** Principle of CNC, types of CNC machine tools, programming and applications of CNC machine tools, Direct Numerical control (DNC), Database and DBMS- requirement, features and architecture of DBMS.

**UNIT - III: GROUP TECHNOLOGY AND FMS****(09 Periods)**

**Group Technology:** Group Technology - Part families, Parts classification and coding, Production flow analysis, Composite part concept, Machine cell design and Benefits of GT.

**Flexible Manufacturing Systems:** FMS - Components of FMS, FMS Work stations, Material Handling Systems, Computer Control system, FMS layout configurations and Benefits of FMS.

**UNIT-IV: COMPUTER AIDED PLANNING SYSTEMS****(09 Periods)**

Computer aided planning systems - Approaches to Computer aided Process Planning (CAPP), Generative and Retrieval CAPP systems, Benefits of CAPP, Material Requirement Planning (MRP), Mechanism of MRP, Benefits of Capacity Planning.

**UNIT - V: ADAPTIVE CONTROL SYSTEMS:****(09 Periods)**

Adaptive control machining system - Adaptive control optimization system, Adaptive control constraint system, Applications to machining processes, Computer process monitoring, Hierarchical structure of computers in manufacturing, and computer process control.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. Mikel.P.Groover, *Automation, Production systems and Computer Integrated Manufacturing Systems*, Pearson Education; 4th Edition, 2016.
2. P.N.Rao, *CAD/CAM: Principles and Applications*, McGraw Hill Education, 3rd edition, 2017.

**REFERENCE BOOKS:**

1. Radhakrishnan and Subramanian, *CAD/CAM/CIM*, New Age International Pvt Ltd, 4<sup>th</sup> Edition, 2018.
2. M. Groover, *CAD/CAM*, Pearson Education; 1<sup>st</sup> Edition, 2003.

**III B. Tech. – I Semester**  
**(19BT50317) CNC PROGRAMMING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Fundamentals of NC And CNC Machines, CNC Machine Elements, CNC Machine Structure and Machining Centers ,Machining Centers, Adaptive Control Systems and Drives, DNC Systems and Adaptive Control, Feedback Devices, Fundamentals of CNC Programming, CNC Part Programming, CNC Turning and Milling Programming, CNC Turning, CNC Milling.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate the knowledge of numerical controls & computerized numerical control of a manufacturing system.
- CO2. Demonstrate the knowledge of constructional and functional features of machines and its support systems.
- CO3. Analyze CNC machines with the knowledge of Adaptive control systems and drive systems considering societal needs.
- CO4. Apply CNC coding used in CNC programming for a given operation.
- CO5. Apply CNC programming for basic Turning and Milling Operations.

**DETAILED SYLLABUS:**

**UNIT- I: FUNDAMENTALS OF NC and CNC MACHINES (09 Periods)**

**NC machines:** Fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems, features of NC Machine tools, interpolations.

**CNC Machines:** CNC machine elements, principle of operation of CNC, features of CNC, classification of CNC systems, Advantages of CNC system, Application of CNC systems.

**UNIT- II: CNC MACHINE STRUCTURE AND MACHINING CENTERS (09 Periods)**

**CNC Machine Structure:** Guide ways, feed drives, spindles, spindle bearings, slide ways - Friction, Antifriction and types of guide ways; Recirculating ball screw; Torque transmission elements - gears, timing belts, flexible couplings and bearings.

**Machining centers:** Features, Auto Tool Changer (ATC) & Automatic Pallet Changer (APC).

**UNIT- III: ADAPTIVE CONTROL SYSTEMS AND DRIVES (09 Periods)**

**DNC Systems and Adaptive Control:** Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, adaptive control with constraints. **Feedback devices** – Open loop and closed loop control systems, positional feedback, velocity feedback devices.

**Drives:** spindle drives-DC shunt motor, 3 phase induction motor, Feed drives-stepper motors, servo principle, DC and AC servomotors.

**UNIT- IV: CNC PROGRAMMING****(09 Periods)**

**CNC PART PROGRAMMING:** Coordinate systems- structure of part program, Types of interpolation, Methods of CNC part programming, Part Program Terminology-G and M Codes, Machine and work piece datum, absolute and incremental programming, tool offset and tool nose radius compensation, fixed cycles, subroutines in part programming, computer-aided part programming, CNC controllers (FANUC and SINUMERIC),

**UNIT- V: CNC TURNING AND MILLING PROGRAMMING****(09 Periods)**

**CNC Turning:** Basic programs on Turning, Facing, Drilling, Threading, Taper Turning, Boring, reaming, and tapping

**CNC Milling:** Basic programs on Face Milling, End Milling, Drilling, Chamfering, Boring, Reaming, Tapping, Sinking.

Features of typical CAM packages: Master CAM, Edge CAM, Siemens NX CAM.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. Mike Mattson, *CNC Programming: Principles & Applications: Principles and Applications*, Delmar; 1st edition, 2013.
2. Yoram Koren, *Computer Control of Manufacturing Systems*, Mc Graw Hill Book Co, 2017.
3. P. Radhakrishnan, *Computer Numerical Control (CNC) Machines*, New Central Book Agency; 1st edition, 2013

**REFERENCE BOOKS:**

1. M. Adithan and B.S. Pable, *CNC Machines*, New Age, Third edition, 2018.
2. Mikell P. Groover, *Automation, Production Systems and Computer-Integrated Manufacturing*, Pearson Education; Fourth edition, 2016.
3. J.S. Narang, *CNC Machines And Automation*, Dhanpat Rai & Co. (P) Limited, 2016.

### III B.Tech. – I Semester

#### (19BT50318) INTRODUCTION TO MECHANICAL SYSTEMS

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

#### PRE-REQUISITES: -

#### COURSE DESCRIPTION:

Statics of rigid bodies; Laws of mechanics; Force couple system; Equilibrium of rigid bodies; Supports and reactions forces; Moment and couple and their representation; Dynamics of rigid bodies; Motion of a rigid bodies; Energy equations; Frictional forces; Robotics and automation; Configuration and anatomy of robots; End effectors; Robotic drive and control systems; Actuators.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Analyze the mechanical behavior of a rigid body and components of forces involved in it.
- CO2. Analyze conditions of equilibrium applied over a rigid body in different dimensions and compute its moments and couples.
- CO3. Analyze the dynamic behavior of a rigid body and its condition of motion.
- CO4. Demonstrate knowledge of robots and its components.
- CO5. Analyze the functional characteristics of robot drives, actuators and controls for a configurations.

#### DETAILED SYLLABUS:

##### UNIT- I: STATICS (09 Periods)

Introduction, Units and Dimensions, Laws of Mechanics, Force Characteristics, System of forces, Lami's theorem, Parallelogram and triangular Law of forces, Statics of rigid bodies in two dimensions, force couple system.

##### UNIT- II: EQUILIBRIUM OF RIGID BODIES (09 Periods)

Free body diagram, Types of supports, Action and reaction forces, Moments and Couples, Moment of a force about a point and about an axis, Vectorial representation of moments and couples, Varignon's theorem, Equilibrium of Rigid bodies in two dimensions.

##### UNIT- III: RIGID BODY DYNAMICS (09 Periods)

Displacements, Velocity and acceleration, their relationship, Relative motion, Curvilinear motion, Newton's laws of motion, Work Energy Equation; Friction force – Laws of sliding friction, Equilibrium analysis of simple systems with sliding friction.

##### UNIT- IV: ROBOTICS (09 Periods)

Robotics and programmable automation, Law of robotics, Anatomy, Configuration of robots, Robot end effectors-classification, force analysis, active and passive grippers.

**UNIT-V: ROBOTIC DRIVES, ACTUATORS & CONTROLS****(09 Periods)**

Functions of Drive Systems, General Types of Fluids, Classification of fluid power systems, Components of hydraulic fluid power systems, components of pneumatic systems, Pump Classification, Introduction to Pneumatic Systems, Electrical Drives, D.C. Motors and Transfer Functions, A.C. Motors, Piezoelectric Actuators, Stepper Motor, Drive Mechanisms.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. Beer F.P, Johnston Jr.E.R, *Vector Mechanics for Engineers Statics and Dynamics*, McGraw Hill Education, 11th Edition, 2017.
2. Mikell P Groover, Mitchell Weiss, Roger N Nagel, Nicholas Odrey, Ashish Dutta *"Industrial Robotics (SIE): Technology, Programming and Applications*, McGraw Hill Education India, 2012.
3. S.R. Deb and S.Deb *"Robotic Technology and Flexible Automation"* McGraw Hill Education India. 2nd Edition, 2012.
4. Khushdeep goyal, Deepak Bhandari, *Industrial automation and robotics*, Katson books, 2013.

**REFERENCE BOOKS:**

1. Hibbeler R.C, Ashok Gupta *"Engineering Mechanics Statics and Dynamics"*, Pearson Education, 11th Edition, 2009.
2. Bhavikatti S.S *"Engineering Mechanics"*, 7th Edition, New Age International (P) Limited Publishers, 2019.
3. Young D H, Timashenko S *"Engineering Mechanics"*, Tata McGraw-Hill., 2006
4. S K Saha *"Introduction to Robotics"*, 2nd Edition, McGraw Hill Education India, 2014.



**III B. Tech. – II Semester**  
**(19BT60321) PRINCIPLES OF INDUSTRIAL AUTOMATION**

|            |            |             |   |   |   |   |
|------------|------------|-------------|---|---|---|---|
| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Introduction to automation, Types of automation systems, Fluid power and fluid power systems, Assembly automation equipment, Material handling, transfer and assembly equipment, Types of automated assembly machines, Programmable Logic Controllers, PLC hardware components, Microprocessors and Microcontrollers, Feedback devices.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate the knowledge on automation and its different applications.
- CO2. Analyze functional characteristics of power systems for industrial applications.
- CO3. Demonstrate the knowledge on assembly automation equipment and its related components.
- CO4. Demonstrate the knowledge of programming logic controller unit for industrial applications.
- CO5. Demonstrate the knowledge of microprocessors and microcontrollers in integrating mechanical systems with computer and electronic systems.

**DETAILED SYLLABUS:**

**UNIT-I: INTRODUCTION TO AUTOMATION (09 Periods)**

History, Elements of Automation, Types of Automation systems, Applications of Automation, Goals of Automation, Low cost automation, Hierarchical levels in industrial Automation systems.

**UNIT-II: FLUID POWER AND FLUID POWER SYSTEMS (09 Periods)**

Introduction to fluid power- Classification of fluid power systems, comparison of electrical, hydraulic and Pneumatic systems; Basic circuit diagram of Hydraulic fluid power and pneumatic power systems, Components of Hydraulic fluid power systems, Components of Pneumatic power system, Logic Gates, Truth tables and Boolean algebra.

**UNIT-III: ASSEMBLY AUTOMATION EQUIPMENT (09 Periods)**

**Material Handling :** Principles of Material handling, Material handling equipment- Wheel conveyor, Gravity Roller conveyor, Chain conveyor, Flat belt conveyor, Magnetic belt

conveyor, bucket conveyor, Vibrating conveyor, screw conveyor, vertical lift conveyor, trolley conveyor, sortation conveyor, cranes and Hoists, storage equipment, AS/RS, AGV.

**Transfer and assembly equipment:** Introduction to feeder units, Cycled transfer equipment and non-cycled transfer equipment.

**Automated assembly machines:** Dial indexing machine, In-line machine, and floating work platform machines.

#### **UNIT-IV: PROGRAMMABLE LOGIC CONTROLLERS (09 Periods)**

**Programmable Logic Controllers (PLC):** Parts of a PLC, Principles of Operation, Modifying the Operation, PLCs versus Computers, PLC Size and Applications.

**PLC hardware Components:** The I/O Section, Discrete I/O Modules, Analog I/O Modules, Special I/O Modules, I/O Specifications, Typical Discrete I/O Module Specifications, Typical Analog I/O Module Specifications, The Central Processing Unit (CPU), Memory Types, Programming Terminal Devices, Recording and Retrieving Data, Human Machine Interfaces (HMIs).

#### **UNIT-V: MICROPROCESSORS AND MICROCONTROLLERS (09 Periods)**

Evolution of microprocessors and microcontrollers; Architectures of microprocessors and microcontrollers; Integration of mechanical systems with computer and electronic systems (Mechatronic systems).

**Feedback devices:** LVDT, Linear/Rotary encoders, absolute encoders, resolvers and potentiometers, Fundamentals of SCADA and Data Acquisition Systems.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

#### **TEXT BOOKS:**

1. Khushdeep Goyal, *Industrial Automation and Robotics*, S.K.Kataria & Sons, 4<sup>th</sup> Edition, 2013.
2. Frank. D. Petruzella, *Programmable Logic Controllers*, Tata McGraw-Hill Education, 4<sup>th</sup> Edition, 2011.

#### **REFERENCE BOOKS:**

1. M.P. Groover, *Automation, Production systems and Computer Integrated Manufacturing*, Fourth edition, PHI Learning, 2016.
2. Geoffrey Boothroyd, *Assembly Automation and Product design*, Taylor and Francis Publishers, Second edition 2005.

### III B.Tech. II-Semester (19BT60322) **PRINCIPLES OF ROBOTICS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

#### **PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Brief history - Robot – Definition, Various robot manipulators – Linear and angular velocities, tactile, proximity and range sensors, End Effectors and robot economics

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate knowledge of robotics, its specifications, functions and different applications.
- CO2. Demonstrate knowledge on various robot manipulators
- CO3. Demonstrate knowledge on sensors, work cells and programming languages.
- CO4. Analyze functional characteristics of robot end effectors through design considerations.
- CO5. Analyze economic aspects of robots by considering different safety parameters.

#### **DETAILED SYLLABUS:**

##### **UNIT-I: BASIC CONCEPTS (09 Periods)**

Brief history, Robot - Definition, Anatomy; Co-ordinate Systems, Work Envelope types and Classification, Robotic Specifications, Pitch, Yaw, Roll, Joint Notations, Speed of Motion, Pay Load, Robot Parts and their Function; Need for Robots, Applications.

##### **UNIT-II: ROBOT MANIPULATORS (09 Periods)**

Various robot manipulators, Linear and angular velocities, Manipulator Jacobian, Prismatic and rotary joints, Robotic Inverse, Wrist and arm singularity.

##### **UNIT-III: ROBOT SENSORS (09 periods)**

Desirable features of Sensors; Tactile, proximity and range sensors; Uses of sensors in robotics; work cell; Introduction to Programming languages.

##### **UNIT-IV: ROBOT END EFFECTORS (09 periods)**

End Effectors-Grippers-Mechanical Grippers, Pneumatic and Hydraulic Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Selection and Design Considerations.

##### **UNIT-V:IMPLEMENTATION AND ROBOT ECONOMICS (09 periods)**

RGV, AGV; Implementation of Robots in Industries-Various Steps; Safety Considerations for Robot Operations - Economic Analysis of Robots.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. R.K.Mittal and I.J.Nagrath, *Robotics and Control*, Tata McGraw Hill, New Delhi, 4th Reprint, 2005.
2. M.P.Groover, M.Weiss, R.N. Nageland N. G.Odrej, *Industrial Robotics*, McGraw-Hill Singapore, 1996.

**REFERENCE BOOKS:**

1. JohnJ.Craig, *Introduction to Robotics Mechanics and Control*, Pearson Education, Third edition, 2009.
2. Ashitava Ghoshal, *Robotics-Fundamental Concepts and Analysis*, Oxford University Press, Sixth impression, 2010.

**III B. Tech. – II Semester**  
**(19BT60323) ROBOT KINEMATICS AND DYNAMICS**

|            |            |             |   |   |   |   |
|------------|------------|-------------|---|---|---|---|
| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Robot Manipulation, Robot Classification, Robot Specifications, Direct Kinematics, Inverse Kinematics, Manipulator Differential Motion and Statics, Manipulator Jacobian, Dynamic Modeling,

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate the knowledge on robot manipulation and control for industrial applications
- CO2. Analyze forward and Inverse kinematics for different robot schemes.
- CO3. Analyze manipulator differential motion and statics for different robot schemes
- CO4. Develop dynamic models for robots using Lagrangian mechanics, Lagrange–Euler formulation, Newton–Euler formulation and other techniques.

**DETAILED SYLLABUS:**

**UNIT-I: ROBOT MANIPULATION (09 Periods)**

Automation and robots; Robot anatomy; Robot Classification; Manipulation and control; Applications; Robot Specifications-Number of axes, Capacity and speed, Reach and stroke, Tool orientation, Repeatability, precision and accuracy, Operating environment.

**UNIT-II: DIRECT KINEMATICS (09 Periods)**

Dot and cross products; coordinate frames; Rotations; Homogeneous coordinates; link coordinates; D-H Representation; The ARM equation; Schematic diagram of four, five and six axis articulated robot.

**UNIT-III: INVERSE KINEMATICS(9 Periods)**

Manipulator workspace; Solvability of inverse kinematic model; Existence of solutions; Multiple solutions, Solution techniques; Closed form solution; The inverse kinematics problem; General properties of solutions; Tool configuration; Inverse kinematics of four axis SCARA robot and six axis articulated robot.

**UNIT-IV: MANIPULATOR DIFFERENTIAL MOTION AND STATICS (09 Periods)**

Linear and angular velocity of a rigid body; Relationships between transformation;

Mapping, Velocity vector; Velocity propagation along links; Manipulator Jacobian; Jacobian inverse; Jacobian singularities; Static analysis.

**UNIT V: DYNAMIC MODELING:**

**(09 Periods)**

Langrangian mechanics; Two degree of freedom manipulator–Dynamic model, Lagrange–Euler formulation, Newton–Euler formulation; Comparison of Lagrange–Euler formulation and Newton–Euler formulation; Inverse dynamics.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. Robert J. Schilling, *Fundamentals of Robotics Analysis and Control*, PHI Learning, 2011.
2. R.K.Mittal and Nagrath, *Robotics and Control*, TMH, 2017.

**REFERENCE BOOKS:**

1. Niku S B, *Introduction to Robotics, Analysis, Systems, Applications*, Prentice Hall, Second edition 2006.
2. Geoffrey Boothroyd, *Assembly Automation and Product design*, Taylor and Francis Publishers, Second edition 2005.

**IV B.Tech I Semester**  
**(19BT70315) APPLIED AND INDUSTRIAL ROBOTICS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** General considerations in Robot material handling, material transfer application, machine loading and unloading, CNC machine tool loading; repeatability, maximum working envelop, kinematic and state values. Robot safety Considerations, Factors affecting robot safety measures; Cooperative manipulation; field robots and robots in health care

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate the knowledge on robotic material handling and assembly systems.
- CO2. Demonstrate the knowledge of expert systems in robotic performance testing and safety
- CO3. Demonstrate the knowledge on various cooperative and SWARM robots and its applications.
- CO4. Analyze robotic configurations and specifications for field and service applications.
- CO5. Demonstrate the core concepts of robots in medical applications.

**DETAILED SYLLABUS:**

**UNIT- I: ROBOT MATERIAL HANDLING (10 Periods)**

General considerations in Robot material handling, material transfer application, machine loading and unloading, CNC machine tool loading, Robot centered cell Assembly and parts presentation methods, Assembly operation, Compliance and the Remote center compliance (RCC) Device, Assembly system configurations, Adaptable programmable assembly system, Designing for robotic assembly, Inspection automations - vision inspection system, robot - manipulated inspection.

**UNIT- II: EXPERT SYSTEMS (09 Periods)**

Factors influencing the choice of a robot, Robot performance testing - Path/point accuracy and repeatability, Maximum working envelop, Kinematic and State values. Robot safety Considerations, Factors affecting robot safety measures, Safety features built into industrial robot, Safety barriers and other devices.

**UNIT-III: COOPERATIVE AND SWARM ROBOTS (07 Periods)**

Cooperative manipulation, Challenges in cooperative manipulation- Case studies for Cooperative manipulation for Industrial and Service applications; Introduction to swarm Robots, Comparison with other multi-agent systems, challenges and benefits of swarm systems- Algorithms for swarm Robots, application, case study of swarm Robots.

**UNIT-IV: FIELD ROBOTS****(10 Periods)**

Forestry, Robot locomotion, Forestry automation, Broad acre Applications- Automatic guidance, sowing, weeding, spraying and broad-acre harvesting; Horticulture, Picking of fruits, Robot milking, Sheep shearing, Slaughtering, livestock inspection, Robots in construction, Future directions; Robots for hazardous applications, Enabling technologies- Search and Rescue robotics: Disaster characteristics-Impact on Robots, Robots actually used at disaster, Promising robots, open issues – Case studies; Cleaning Robots, lawn moving Robots- Smart appliances and smart homes.

**UNIT-V: ROBOTS IN HEALTH CARE****(09 Periods)**

Medical robotics, Core concepts, Technology- Medical robotic systems, Research areas and applications; Rehabilitation and Health care robotics- Overview, physical therapy and training Robots; Robotic aid for people with disabilities- Smart prostheses and orthoses, diagnosis and monitoring.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, *Industrial Robotics Technology, Programming and Applications*, Mc Graw Hill Book company, 4<sup>th</sup> edition, 2016.
2. Bernard Hodges, *Industrial Robotics*, Second Edition, Jaico Publishing House, 1993.

**REFERENCE BOOKS:**

1. Yangsheng Xu Huihuan Qian Xinyu Wu, *Household and Service Robots*, Elsevier Ltd, 2015.
2. Aleksandar Lazinica, *Mobile Robots Towards New Applications*, Advanced Robotic Systems International, 2006.
3. LMarques, AdeAlmeida, Mo Tokhi, GSVirk, *Advances in Mobile Robotics*, World Scientific Publishing Co. Pte.Ltd. 2008.
4. Bruno Siciliano, Oussama Khatib, *Springer Handbook of Robotics*, Springer-Verlag Berlin Heidelberg, 2008.



**IV B.Tech. – I Semester**  
**(19BT70316) ROBOTIC PROGRAMMING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Robotic programming; Robotic software functions; Program planning; Modes of programming; Commands for motion control; Lead through robotic programming; Textual robotic programming; End effectors and sensors commands; Program control and subroutines; VAL II Programming; AML Programming;

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate the knowledge of basic planning schemes involved in development of robotic programming.
- CO2. Develop Programmes for robots based on the techniques of pendant and command control.
- CO3. Demonstrate the knowledge of robotic languages for operations and control.
- CO4. Develop Programs for robots on VAL II platform with a complete command-based control.
- CO5: Develop Programs for robots on AML platform with a complete command-based control.

**DETAILED SYLLABUS:**

**UNIT- I: FUNDAMENTALS OF ROBOT PROGRAMMING (09 Periods)**

Robot software functions - coordinate systems, Position control, Other control functions, sub-routines, Planning of robotic programming using flow charting - examples.

**UNIT-II: METHODS OF ROBOT PROGRAMMING (09 Periods)**

Online programming, off-line programming advantages of off-line programming; lead through methods - powered lead through, manual lead through, Teach pendant; Robot program as a path in space, defining position in space, motion interpolation, WAIT, SIGNAL and DELAY commands, Branching capabilities and Limitations of lead through methods.

**UNIT-III: ROBOT LANGUAGES (09 Periods)**

Textual robot Languages, first generation and Second-generation languages, Structure of a robot language - Operating Systems, Elements and Functions, Constants, Variables and Other data objects, Motion commands, Points in workspace, End effectors and sensor commands, Computations and operations, Program control and subroutines, Communications and Data processing.

**UNIT-IV: VARIABLE ASSEMBLY LANGUAGE****(09 Periods)**

Variable Assembly Language II - Introduction, Monitor commands, motion command, Hand Control, Configuration control, interlock commands, INPUT/OUTPUT Controls, Program Control, Examples

**UNIT- V: A MANUFACTURING LANGUAGE****(09 Periods)**

A Manufacturing Language(AML) - Introduction, AML statements, Constant and variables, Program control statements, motion commands, Sensor commands; Grip sensing capabilities, Data processing, Examples.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. Mikell P. Groover, Mitchell Weiss, Roger N. Nagel and Nicholas G. Odrey, *Industrial Robotics Technology, Programming and Applications*, McGraw Hill Book company, 1986
2. Bernard Hodges, *Industrial Robotic*, Jaico Publishing House, 2<sup>nd</sup> Edition, 1993.
3. S.R. Deb and S.Deb *Robotic Technology and Flexible Automation*, Second Edition McGraw Hill Education India., 2012

**REFERENCE BOOKS:**

1. JJ Craig, *Introduction to Robotic Mechanics and Control*, Pearson, 3<sup>rd</sup> edition, 2004.
2. Fu, Lee and Gonzalez, *Robotics, control vision and intelligence*, McGraw Hill International, 2nd edition, 1987.

**IV B.Tech. – I Semester**  
**(19BT70317) SENSORS AND MACHINE VISION SYSTEMS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Vision systems; Components of vision systems; Elements of visual perception; Low level vision; Filters; Higher level vision; Boundary and regional description; Sensors in robots; Different sensing variables; Robotic control; Robotic operating System; Open CV.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate the knowledge of vision system components and image interfaces.
- CO2. Demonstrate the knowledge of image representations and filters for low level vision system.
- CO3. Demonstrate the knowledge of higher level vision for industrial applications.
- CO4. Analyze functional characteristics of sensors incorporated in a robot system.
- CO5. Demonstrate the knowledge on robotic operating system and vision system for robotic simulation.

**DETAILED SYLLABUS:**

**UNIT-I: VISION SYSTEM (09 Periods)**

Basic Components, Elements of visual perception: structure of human eye, Image formation in the eye – pinhole cameras – color cameras – Image formation model – Imaging components and illumination techniques-Picture coding-Basic relationship between pixels -Camera-Computer interfaces.

**UNIT-II: LOW-LEVEL VISION (09 Periods)**

Image representation-Gray level transformations, Histogram, Image subtraction, Image averaging – Filters: Smoothing spatial filters, sharpening spatial filters, smoothing frequency domain filters, sharpening frequency domain filters-Edge detection.

**UNIT-III: HIGHER LEVEL VISION: (09 Periods)**

Segmentation-Edge linking and Boundary Detection, Thresholding, Region-oriented segmentation, the use of motion Description: Boundary Descriptors, Regional Descriptors, Recognition: Decision-Theoretic methods, structural methods.

**UNIT-IV: SENSORS IN ROBOTICS (09 Periods)**

Position sensors – optical, non-optical, Velocity sensors, Accelerometers, Proximity Sensors – Contact, non-contact, Range Sensing, touch and Slip Sensors, Force and Torque Sensors. Different sensing variables – smell, Heat or Temperature, Humidity, Light, Speech or Voice recognition Systems, Telepresence and related technologies, robot control through vision

## **UNIT-V:ROBOT VISION**

**(09 Periods)**

Robotic operating System (ROS) -Introduction, Real and Simulated Robots; Introduction to OpenCV, Open NI and PCL, installing and testing ROS camera Drivers, ROS to OpenCV – The CV\_bridge Package.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

### **TEXT BOOKS:**

1. K.S.Fu, R.C.Gonzalez, CSG.Lee, *-Robotics control, sensing, vision and Intelligencell*, McGraw Hill EducationPvt.Ltd., 2017.
2. Richard D. Klafter, Thomas A. Chmielewski, Michael Negin, *Robotics Engineering: An Integrated Approach*, PHI Learning, New Delhi, 2009.

### **REFERENCE BOOKS:**

1. Damian M.Lyons, *Cluster Computing for Robotics and Computer Vision*, World Scientific, Singapore, 2011.
2. Rafael C.Gonzalez, Richard E.Woods, StevenL. Eddins, *Digital Image Processing using MATLAB* , 2<sup>nd</sup> edition, Tata McGrawHill, 2010.
3. Carsten Steger, Markus Ulrich, Christian Wiedemann,-*Machine Vision algorithms and Applications*, WILEY-VCH, Weinheim, 2008.
4. Kenneth Dawson-Howe, *-A Practical Introduction to Computer Vision with OpenCV*, Wiley, Singapore, 2<sup>nd</sup> edition, 2013.

## **MINOR DEGREE IN SUSTAINABLE ENGINEERING**

**Offering Department:** CIVIL ENGINEERING

**Students of Eligible Branches:** CSE, CSSE, IT, ECE, EEE, EIE and ME

### **COURSE STRUCTURE**

| Year & Semester                  | Course Code | Course Title                             | Contact Periods per week |   |   |       | C | Scheme of Examination Max. Marks |            |             |
|----------------------------------|-------------|------------------------------------------|--------------------------|---|---|-------|---|----------------------------------|------------|-------------|
|                                  |             |                                          | L                        | T | P | Total |   | Int. Marks                       | Ext. Marks | Total Marks |
| III B.Tech. I-Sem<br>(2 Theory)  | 19BT40107   | Sustainable Engineering*                 | 3                        | - | - | 3     | 3 | 40                               | 60         | 100         |
|                                  | 19BT50110   | Ecology and Environmental Impact         | 3                        | - | - | 3     | 3 | 40                               | 60         | 100         |
|                                  | 19BT50111   | Waste to Energy                          | 3                        | - | - | 3     | 3 | 40                               | 60         | 100         |
| III B.Tech. II-Sem<br>(2 Theory) | 19BT60126   | Environmental Sustainability             | 3                        | - | - | 3     | 3 | 40                               | 60         | 100         |
|                                  | 19BT60127   | Sustainable Energy Systems               | 3                        | - | - | 3     | 3 | 40                               | 60         | 100         |
|                                  | 19BT60128   | Sustainability in The Built Environment  | 3                        | - | - | 3     | 3 | 40                               | 60         | 100         |
| IV B.Tech. I-Sem<br>(2 Theory)   | 19BT70117   | Environmental Economics                  | 3                        | - | - | 3     | 3 | 40                               | 60         | 100         |
|                                  | 19BT70118   | Sustainable Cities                       | 3                        | - | - | 3     | 3 | 40                               | 60         | 100         |
|                                  | 19BT70119   | Sustainable Design of Technology Systems | 3                        | - | - | 3     | 3 | 40                               | 60         | 100         |

\*Compulsory Course if not studied in Major Degree.

**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

**III B. Tech. - I Semester**  
**(19BT40107) SUSTAINABLE ENGINEERING**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES: -**

**COURSE DESCRIPTION:** Principles of sustainability; Sustainability metrics and assessment tools; Sustainable engineering practices; Sustainable engineering applications; Sustainable urbanization and industrialization.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Analyze the principles of sustainability to solve complex environmental problems following relevant standards/protocols considering society, health, safety and environment.
- CO2. Analyze sustainability metrics and assessment tools to solve complex environmental problems following relevant standards and emerging trends considering society, health, safety, environment and economics besides communicating effectively in graphical form.
- CO3. Analyze sustainable engineering practices to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.
- CO4. Design sustainable engineering applications to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.
- CO5. Analyze sustainable urbanization and industrialization principles to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT - I: PRINCIPLES OF SUSTAINABILITY (09 Periods)**

Emerging challenges, Sustainability and sustainable engineering; Environmental concerns; Social, economic and legal issues; Availability and depletion of natural resources, Disaster resiliency; Multilateral environmental agreements – Basel convention, Clean development mechanism (CDM), Montreal and Kyoto protocols.

**UNIT – II: SUSTAINABILITY METRICS AND ASSESSMENT TOOLS (09 Periods)**

Sustainability indicators, metrics and assessment tools, Material flow analysis and material budget, Carbon footprint analysis, Life cycle assessment, Streamlined life-cycle assessment (SLCA), Economic input output-life cycle analysis, Environmental health risk assessment, Other emerging assessment tools.

**UNIT - III: SUSTAINABLE ENGINEERING PRACTICES****(09 Periods)**

Sustainable energy engineering, Sustainable waste management, Green and sustainable buildings and infrastructure, Sustainable civil infrastructure, Sustainable remediation of contaminated sites, Climate geoengineering.

**UNIT - IV: SUSTAINABLE ENGINEERING APPLICATIONS****(09 Periods)**

Environmental and chemical engineering projects, Materials engineering projects, Infrastructure engineering projects – Background, Methodology, Goal and Scope, Study area, Technical design, Environmental sustainability, Life cycle assessment, Economic sustainability, Social sustainability, Rating systems – ENVISION, LEED, GRIHA, IGBC; Conclusions.

**UNIT – V: SUSTAINABLE URBANIZATION AND INDUSTRIALIZATION****(09 Periods)**

Sustainable urbanization and industrialization, United Nations sustainable development goals – Right to education, Poverty eradication, Social and technological changes; Industrial Processes - Material selection, Energy efficiency, Pollution prevention and control techniques, Industrial Ecology, Industrial symbiosis.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan.***

**TEXT BOOKS:**

1. Reddy, K. R., Cameselle, C., and Adams, J. A., *Sustainable Engineering: Drivers, Metrics, Tools, and Applications*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2019,
2. Allen, D. T. and Shonnard, D. R., *Sustainability Engineering: Concepts, Design and Case Studies*, Pearson Education, 1<sup>st</sup> Edition, 2012.

**REFERENCE BOOKS:**

1. Bradley. A. S; Adebayo, A. O., Maria, P., *Engineering Applications in Sustainable Design and Development*, Cengage Learning, 1<sup>st</sup> Edition, 2016.
2. Purohit, S. S., *Green Technology: An Approach for Sustainable Environment*, Agrobios Publication, 1<sup>st</sup> Edition, 2016.
3. *Energy Conservation Building Code (ECBC) 2007*, Bureau of Energy Efficiency, Govt. of India, New Delhi.
4. Twidell, J. W. and Weir, A. D., *Renewable Energy Resources*, Routledge, Taylor & Francis Group, 3<sup>rd</sup> Edition, 2015.

**ADDITIONAL LEARNING RESOURCES:**

1. Daniel A. Vallero and Chris Brasier, *Sustainable Design: The Science of Sustainability and Green Engineering*, Wiley-Blackwell, 1<sup>st</sup> Edition, 2008.
2. Jorge A. Vanegas, *Sustainable Engineering Practice: An Introduction*, Committee on Sustainability, American Society of Civil Engineers, <https://doi.org/10.1061/9780784407509>, 2004.
3. Mackenthun, K. M., *Basic Concepts in Environmental Management*, CRC Press, Taylor & Francis Group, 1<sup>st</sup> Edition, 1999.
4. *Environment Impact Assessment Guidelines*, Notification of Government of India, 2006.

### III B. Tech. - I Semester

#### (19BT50110) **ECOLOGY AND ENVIRONMENTAL IMPACT**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** A course on Environmental Science

**COURSE DESCRIPTION:** Ecology; Ecosystem; Ecological impact assessment, Ecotoxicology and bio-monitoring, Restoration ecology.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1. Demonstrate the basic knowledge on ecology to provide solutions to environmental problems using appropriate tools and techniques considering society, health, environment and sustainability besides communicating effectively in graphical form.
- CO2. Analyze the ecosystems to solve environmental problems using appropriate tools and techniques considering society, health, safety, environment and sustainability besides communicating effectively in graphical form.
- CO3. Analyze the ecological impact assessment to solve complex environmental problems using appropriate tools and techniques following relevant standards and norms considering society, health, safety, environment, sustainability and economics besides communicating effectively in graphical form.
- CO4. Analyze the eco-toxicology effects and bio-monitoring of ecosystems to solve complex environmental problems using appropriate tools and techniques following relevant standards and norms considering society, health, safety, environment, sustainability and project management besides communicating effectively in graphical form.
- CO5. Analyze ecology of disturbed ecosystems, reconstructions and restoration of natural ecosystems to solve complex environmental problems following relevant standards and latest developments considering society, health, safety, environment, sustainability and project management besides communicating effectively in graphical form.

#### **DETAILED SYLLABUS:**

##### **UNIT - I: ECOLOGY**

**(10 Periods)**

Scope, concept and multidisciplinary nature of ecology; Organizational level of ecological systems, Abiotic and biotic environment, Limiting factors, Adaptation, Habitat and niche, Holocoenotic nature of environment, Concept of biosphere; Landscape, population and community ecology; Synecological principles, Species area relations, Methods of sampling and describing plant community, Ecological succession, Succession models, Concept of climax.

##### **UNIT - II: ECOSYSTEM**

**(08 Periods)**

Structure and function of ecosystems, Productivity, Decomposition, Energy flow, Ecological efficiencies, Ecological pyramids, Global pattern of productivity, Nutrient cycling (Carbon, Nitrogen and Phosphorus), Ecosystem stability – Inertia, Resilience; Fragile ecosystem, Hot spots, Ecosystem services, Net Present Value (NPV) of ecosystems, Major biomes of India and the world.



### **UNIT - III: ECOLOGICAL IMPACT ASSESSMENT (09 Periods)**

Principles and practices of ecological assessment, Carrying capacity of environment and earth, Environmental quality, Ecological and social impact of man, Resource depletion, Loss of biological diversity, Land degradation and deforestation, Impact assessment methods through case studies at organism, Community and ecosystem levels, Detailed criteria, Survey methods and evaluation, Cost benefit analysis, Prediction of impacts on physical environment and biotic communities through modelling, Developing impact statement.

### **UNIT - IV: ECOTOXICOLOGY AND BIO-MONITORING (08 Periods)**

**Ecotoxicology:** Ecotoxicology - Background, importance and measurement; LC50, EC50, NOEC, LOEC, Toxic units, Ecosystem response to de-oxygenation; Eutrophication - Kinetics, Lake phosphorous model, Pesticides.

**Bio-monitoring:** Bio-monitoring, Active and passive monitoring, Concept of bioaccumulation, Bio-indicator parameters, Bio-air conditioning and bio-purifiers, Pollution tolerance index of plants, Green belt development, Plant protection and protective substances to pollution stress, Data-gathering techniques, Organization of the survey and data analysis.

### **UNIT - V: RESTORATION ECOLOGY (10 Periods)**

Ecological theories and principles that guide restoration practices in a variety of ecosystems, Causes of ecosystem degradation, Motivations for restoration, Factors that influence success in restoration; Ecology of disturbed ecosystems - Disturbance and its impact on the structure and functioning of terrestrial and aquatic ecosystems; Aims and strategies of restoration - Concepts of restoration, Single vs. multiple end-points, Ecosystem reconstructions, Physical, chemical, biological and biotechnological tools of restoration; Restoration of biological diversity - Acceleration of ecological succession, Reintroduction of biota; Degradation and restoration of natural ecosystems - Rivers, Wetlands, Forests, Grassland, Savanna, Aquatic; Restoration of degraded soils - Restoration of contaminated soils and soil fertility, Mine spoil restoration.

**Total Periods: 45**

**Topics for self-study are provided in the lesson plan.**

#### **TEXT BOOKS:**

1. Saha, T. K., *Ecology and Environmental Biology*, Books and Allied (P) Ltd., Kolkata, 1<sup>st</sup> Edition, 2010.
2. Walker, C. H., Hopkin, S. P., Sibly R. M. and Peakall, D. B., *Principles of Ecotoxicology*, Taylor and Francis Group, London, 2<sup>nd</sup> Edition, 2004.
3. Palmer, M. A., Zedler, J. B. and Falk, D. A., *Foundations of Restoration Ecology*, Island Press, USA, 2016.

#### **REFERENCE BOOKS:**

1. Dash, M. C. and Dash, S. P., *Fundamentals of Ecology*, Tata - McGraw Hill, New Delhi, 3<sup>rd</sup> Edition, 2001.
2. Smith, T. M. and Smith, R. L., *Elements of Ecology*, Pearson Education Ltd., England, 9<sup>th</sup> Edition, 2015.
3. Hughes, W., *Essentials of Environmental Toxicology*, Taylor & Francis Press, USA, 2005.
4. Wathern, P., and Hynman, U., *Impact Assessment and Sustainable Resource Management-Theory and Practice*, Routledge Press, 2014.
5. Westman, W. E., *Ecology, Impact Assessment and Environmental Planning*, John Wiley, New York, 1985.

**ADDITIONAL LEARNING RESOURCES:**

1. Rajgopalan, R., *Environment and Ecology - A Complete Guide*, OakBridge Publishing, 2<sup>nd</sup> Edition, 2019.
2. Charles J. Krebs, *Ecology: The Experimental Analysis of Distribution and Abundance*, Pearson Education India, 6<sup>th</sup> Edition, 2008.
3. Mani, M., Ganesh, L.S. and Varghese, K., *Sustainability and Human Settlements*, Sage Publications, New Delhi, 1<sup>st</sup> Edition, 2005.

**III B. Tech. - I Semester**  
**(19BT50111)WASTE TO ENERGY**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** A course on Environmental Science.

**COURSE DESCRIPTION:** Waste to energy concept; Municipal solid waste; Thermochemical waste to energy technologies; Biological waste to energy technologies; Waste to energy plants and the environment.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1 Analyze waste to energy process to solve waste management challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO2 Analyze municipal solid waste characteristics and sampling techniques to solve solid waste management challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO3 Analyze thermochemical waste to energy technologies to solve solid waste management challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO4 Analyze traditional and advanced biological technologies for converting waste to energy using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO5 Analyze energy plants and the environment to solve waste to energy challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT - I: WASTE TO ENERGY CONCEPT (09 Periods)**

Waste to energy- A historical perspective, Waste as a renewable resource, Global production of power from waste; The politics of waste - Waste management hierarchy, Circular economy/zero Waste, Energy from waste with the circular economy concept.

**UNIT - II: MUNICIPAL SOLID WASTE (08 Periods)**

Sources and types of solid waste, Quantity, Factors affecting generation of solid waste, Characteristics, Waste classification, Methods of sampling and characterization, Energy content of the waste.

**UNIT - III: THERMOCHEMICAL WASTE TO ENERGY TECHNOLOGIES (10 Periods)**

Traditional waste combustion technologies - Waste processing and treatment facility, Rotary combustors, Fluidized bed combustors; Energy production from waste through advanced thermochemical techniques - Incineration, Gasification and Pyrolysis.

**UNIT - IV: BIOLOGICAL WASTE TO ENERGY TECHNOLOGIES (10 Periods)**

Energy production from waste through biological techniques - Anaerobic digestion, Fermentation, Transesterification, Advanced microbial fuel cells; Cultivation of algal biomass from wastewater and energy production from algae.

**UNIT - V: WASTE TO ENERGY PLANTS AND THE ENVIRONMENT (08 periods)**

Emission limits for waste combustion, Environmental politics and science, Waste to energy plant cost, Latest developments in waste to energy, Case Studies.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan.***

**TEXT BOOKS:**

1. Breeze, Paul, *Energy from Waste*, Academic Press, 1<sup>st</sup> Edition, 2017.
2. Singh, R. P., Prasad, V. and Vaish, B., *Advances in Waste-to-Energy Technologies*, CRC Press, 1<sup>st</sup> Edition, 2019.

**REFERENCE BOOKS:**

1. Maczulak, A. E., *Environmental Engineering: Designing a Sustainable Future*, Infobase Publishing, 4<sup>th</sup> Edition, 2010.
2. Kalogirou, E. N., *Waste-to-Energy Technologies and Global Applications*, CRC Press, 1<sup>st</sup> Edition, 2017.
3. Klinghoffer, N. B., & Castaldi, M. J., *Waste to Energy Conversion Technology*, Elsevier, 3<sup>rd</sup> Edition, 2013.

**ADDITIONAL LEARNING RESOURCES:**

1. Rogoff, M. J., & Screve, F., *Waste-to-energy: Technologies and Project Implementation*, Academic Press, 1<sup>st</sup> Edition, 2019.
2. Trabold, T., and Babbitt, C. W., *Sustainable Food Waste-to-Energy Systems*, Academic Press, 1<sup>st</sup> Edition, 2018.

**III B. Tech. - II Semester**  
**(19BT60126) ENVIRONMENTAL SUSTAINABILITY**

| Int. Marks | Ext. Marks | Total | L | T | P | C |
|------------|------------|-------|---|---|---|---|
| 40         | 60         | 100   | 3 | - | - | 3 |

**PREREQUISITES:** Courses on Environmental Science & Sustainable Engineering

**COURSE DESCRIPTION:** Environmental measurements from different disciplines and sustainability concepts; Environmental chemistry and physical process in environment; Environmental risk assessments with concepts of EIA and LCA; Sustainability assessment of water and wastewater treatment; Sustainability assessment of solid waste management and air pollution issues.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1: Analyze environmental measurements and sustainability concepts to solve environmental sustainability challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO2: Analyze environmental chemistry and physical processes to solve environmental sustainability challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO3: Analyze environmental risk assessment with concepts of EIA and LCA to solve environmental sustainability problems using appropriate tools and techniques following relevant codes and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO4: Analyze water and wastewater treatment to solve environmental sustainability problems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering health, society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO5: Analyze sustainable assessment of solid waste management and air pollution issue to solve complex problems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering health, society, environment, sustainability and economics besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT – I: ENVIRONMENTAL MEASUREMENTS FROM DIFFERENT DISCIPLINES AND SUSTAINABILITY CONCEPTS (09 Periods)**

Environmental measurements - Mass concentration units, Partial pressure units, Other types of units, Qualitative and quantitative measurements; Sustainability concepts and evolution, Engineering for sustainability.

**UNIT – II: ENVIRONMENTAL CHEMISTRY AND PHYSICAL PROCESS IN ENVIRONMENT (09 Periods)**

Environmental chemistry, Mass balance and reactor systems; Mass balance in continuous reactor, continuous stirred tank reactor (CSTR) and Plug flow reactor; Plug flow reactor and energy flow, Energy balance and earth overshoot day, Mass transport processes.

### **UNIT – III: ENVIRONMENTAL RISK ASSESSMENT WITH CONCEPTS OF EIA AND LCA (09 Periods)**

Life Cycle Assessment (LCA); Environmental Impact Assessment (EIA) - Fundamentals, Evolution of EIA (Global and Indian Scenario), Elements of EIA– Screening, Scoping, Public consultation, Environmental clearance process in India - Key elements in 2006 EIA (Govt. of India) notification; Environmental risk, Environmental impact calculation by using LCA technique, Risk assessments with concepts of EIA and LCA, Case studies.

### **UNIT – IV: SUSTAINABILITY ASSESSMENT OF WATER AND WASTEWATER TREATMENT (08 Periods)**

Sustainability assessment in Water purification – Processes, Engineered systems – Aeration, Solids separation, Settling operations, Coagulation, Softening, Filtration, Disinfection; Sustainability assessment in wastewater treatment process and disposal – Primary, Secondary and Tertiary.

### **UNIT – V: SUSTAINABILITY ASSESSMENT OF SOLID WASTE MANAGEMENT AND AIR POLLUTION ISSUES (10 Periods)**

Sustainability assessment of solid waste management –Need and scope; Municipal solid waste – Types, Composition and characteristics; Methods of collection and transportation; Methods of disposal – Open dumping, Sanitary landfill, Composting and Incineration; Utilization - 6R Concept; Sustainability assessment of air pollution issues – Need and scope, Classification, Sources – Line, Area, Stationary, Mobile; Effects of air pollutants on man, Material and vegetation; Global effects of air pollution.

**Total Periods: 45**

***Topics for self-study are included in the lesson plan.***

#### **TEXT BOOKS:**

1. Davis, M. L. and Cornwell, D. A., *Introduction to Environmental Engineering*, McGraw-Hill, 5<sup>th</sup> Edition, 2008.
2. Keong, Choy Yee, *Global Environmental Sustainability: Case Studies and Analysis of the United Nations' Journey toward Sustainable Development*, Elsevier, 2020.

#### **REFERENCE BOOKS:**

1. Singh, Ritu, and Sanjeev Kumar, *Green Technologies and Environmental Sustainability*, Springer, 2<sup>nd</sup> Edition, 2017.
2. Joumard, Robert, and Henrik Gudmundsson, *Indicators of Environmental Sustainability in Transport: An Interdisciplinary Approach to Methods*, European Commission, 2<sup>nd</sup> Edition, 2010.
3. Smith, Fraser, *Environmental Sustainability: Practical Global Applications*, CRC Press, 1<sup>st</sup> Edition, 2020.

#### **ADDITIONAL LEARNING RESOURCES:**

1. Burke, G., Singh, B. R. and Theodore, L., *Handbook of Environmental Management and Technology*, John Wiley & Sons, 2<sup>nd</sup> Edition, 2000.
2. Peavy, Howard S., Donald R. Rowe, and George Tchobanoglous, *Environmental Engineering*, McGraw-Hill, Indian Edition, 1<sup>st</sup> Edition, 2017.

**III B. Tech. - II Semester**  
**(19BT60127) SUSTAINABLE ENERGY SYSTEMS**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PREREQUISITES:** Courses on Environmental Science & Sustainable Engineering

**COURSE DESCRIPTION:** The energy landscape and sustainability; Solar and wind energy; Biomass, geothermal, tidal and wave energies; Electricity storage technologies; Grid integration of renewable energy.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1 Analyze the energy landscape and sustainability to provide solutions to energy problems using appropriate tools and techniques following relevant standards considering society, health and environment besides communicating effectively in graphical form.
- CO2 Analyze solar and wind energy systems to solve the complex energy problems using appropriate tools and techniques following relevant standards considering society, health, environment, sustainability and economics besides communicating effectively in graphical form.
- CO3 Analyze biomass, geothermal, tidal and wave energy systems to solve the complex energy problems using appropriate tools and techniques following relevant standards considering society, health, environment, sustainability and economics besides communicating effectively in graphical form.
- CO4 Analyze electric storage technology systems to solve the complex energy problems using appropriate tools and techniques following relevant standards and latest developments considering society, health, environment, sustainability and economics besides communicating effectively in graphical form.
- CO5 Analyze grid integration of renewable energy to solve the complex energy problems using appropriate tools and techniques following relevant standards considering society, health, environment, sustainability and economics besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT - I: THE ENERGY LANDSCAPE AND SUSTAINABILITY (09 Periods)**

Current global energy use, National and international energy consumption and related greenhouse gas emissions, Lifetime of fossil fuels, Sustainability and energy use, Energy conversion technologies, Energy forms and conversion, First and second laws of thermodynamics and efficiencies; Devices - Heat engines, Refrigerators, Heat pumps; Instantaneous and average power.

**UNIT - II: SOLAR AND WIND ENERGY (09 Periods)**

Principles of solar radiation, Resource foundations, Technology challenges, Sustainability, Solar energy industry and economics, Net Metering; Origin of the wind, Power in the wind, Wind resource basics, Wind energy technologies, Challenges, Sustainability, Wind energy Industry.

**UNIT - III: BIOMASS, GEOTHERMAL, TIDAL AND WAVE ENERGIES (09 Periods)**

Sources of feedstocks; Biofuels - Bioethanol, Biodiesel, Algal, Jatropha and Biogas; Conversion technology, Diesel and ethanol, Biogas, Electricity production,

Transportation, Challenges, Sustainability, Economics; Geothermal energy - Principles, Geothermal potential and technology, Electricity production, Conversion technology, Challenges, Economics; Tidal and wave energies, Conversion technologies, Sustainability.

**UNIT - IV: ELECTRICITY STORAGE TECHNOLOGIES (09 Periods)**

Introduction, Battery energy storage technologies - Lithium-ion batteries, Full cells, Nickel-based batteries, Lead-acid batteries, Sodium-sulfur batteries; Hydro energy storage - Applications of pump hydro energy storage plant, Site selection for pump hydro energy storage plant; Thermal energy storage, Capacitors and applications, Latest developments.

**UNIT - V: GRID INTEGRATION OF RENEWABLE ENERGY (09 Periods)**

Variability, Intermittency and dispatchability, Electric grid infrastructure, Integrating renewable energy into the grid, Growing a more efficient grid, The smart grid, Secure communication in the smart grid; Cogeneration plant and power distribution in industry, Micro grids.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan.***

**TEXT BOOKS:**

1. Boyle, Godfrey, *Renewable Energy: Power for a Sustainable Future*, Oxford University Press, 3<sup>rd</sup> Edition, 2012.
2. Jefferson W. Tester, Elisabeth M. Drake, Michael J. Driscoll, Michael W. Golay, William A. Peters, *Sustainable Energy (Choosing Among Options)*, MIT Press, 2<sup>nd</sup> Edition, 2012.

**REFERENCE BOOKS:**

1. Gilbert M. Masters, *Renewable and Efficient Electric Power Systems*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2<sup>nd</sup> Edition, 2013.
2. Vanek, F.M., Albright, L.D., *Energy Systems Engineering - Evaluation and Implementation*, McGraw-Hill, 2<sup>nd</sup> Edition, 2008.
3. David MacKay, *Sustainable Energy: Without the Hot Air*, UIT Cambridge Ltd., Cambridge, England, 2009.
4. Frank Kreith, *Principles of Sustainable Energy Systems*, CRC Press, Taylor and Francis group, 2<sup>nd</sup> Edition, 2014.

**ADDITIONAL LEARNING RESOURCES:**

1. Richter Burton, *Beyond Smoke and Mirrors: Climate Change and Energy in the 21<sup>st</sup> Century*, Cambridge University Press, New York, 2010.



**III B. Tech. - II Semester**  
**(19BT60128) SUSTAINABILITY IN THE BUILT ENVIRONMENT**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on 280Environmental Science & Sustainable Engineering.

**COURSE DESCRIPTION:** Sustainable urban development; Sustainable site planning and analysis; Sustainable buildings; Building envelope and services; Management of sustainable built environment.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1 Analyze sustainable urban development to solve problems associated with the built environment using appropriate tools and techniques following relevant standards considering society, health and environment besides communicating effectively in graphical form.
- CO2 Analyze sustainable site planning to solve complex problems associated with the built environment using appropriate tools and techniques following relevant standards considering society, health and environment besides communicating effectively in graphical form.
- CO3 Analyze sustainable buildings to solve complex problems associated with the built environment using appropriate tools and techniques following relevant standards considering society, health and environment besides communicating effectively in graphical form.
- CO4 Analyze building envelope and services to solve complex problems associated with the built environment using appropriate tools and techniques following relevant standards considering society, health and environment besides communicating effectively in graphical form.
- CO5 Analyze management of sustainable built environment to solve complex problems using appropriate tools and techniques following relevant standards considering society, health and environment besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT-I: SUSTAINABLE URBAN DEVELOPMENT (09 Periods)**

Urban development - Human activities and their effects; Carbon cycle; Role of construction material such as concrete and steel; CO<sub>2</sub> contribution from cement and other construction materials; GHG emissions - Global climate change; Efforts in sustainable development and construction - Universal efforts, International organizations involved.

**UNIT - II: SUSTAINABLE SITE PLANNING AND ANALYSIS (09 Periods)**

Sustainable site planning, Principles of site analysis, Improving sustainability of a site – Stormwater, Reducing site disturbance, Vegetation; Site analysis - Examples of site analysis; Introduction to alternative energy - Solar, Wind, Hydro, Biofuel etc.

**UNIT - III: SUSTAINABLE BUILDINGS (09 Periods)**

Introduction to sustainable buildings and standards, Green buildings, Energy efficiency and sustainability; Passive House; Net Zero Energy Buildings (NZEB), Examples of different types of NZEB.

**UNIT - IV: BUILDING ENVELOPE AND SERVICES (09 Periods)**

Building envelope effect and energy efficiency measures, Renewable energy integration, Sustainable building services, Sustainable construction and materials, Integrated design, Energy use and CO<sub>2</sub>, Built environment - Aging and susceptibility to natural disasters.

**UNIT – V: MANAGEMENT OF SUSTAINABLE BUILT ENVIRONMENT (09 Periods)**

Life cycle planning, Measuring sustainability; Facilities management - Waste management, Improved amenities, Improved transport infrastructure, Social mix, Accessibility issues, Cultural and historical issues.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan***

**TEXT BOOKS:**

1. Alison Cotgrave and Mike Riley, *Total Sustainability in the Built Environment*, Macmillan Education, 1<sup>st</sup> Edition, 2012.
2. Kevin Lynch and Gary Hack, *Site Planning*, MIT Press, 3<sup>rd</sup> Edition, 1984.

**REFERENCE BOOKS:**

1. William McLean and Pete Silver, *Environmental Design Source Book: Innovative Ideas for a Sustainable Built Environment*, RIBA Publishing, 1<sup>st</sup> Edition, 2021.
2. Tim Dixon, John Connaughton, Stuart Green, *Sustainable Futures in the Built Environment to 2050: A Foresight Approach to Construction and Development*, John Wiley & Sons Ltd., 2018.
3. Rob Fleming, Saglinda H Roberts, *Sustainable Design for the Built Environment*, Routledge Press, London, 1<sup>st</sup> Edition, 2019.
4. Charles J. Kibert, *Sustainable Construction: Green Building Design and Delivery*, Wiley, 4<sup>th</sup> Edition, 2021.

**ADDITIONAL LEARNING RESOURCES:**

1. Mani, M., Ganesh, L.S. and Varghese, K., *Sustainability and Human Settlements*, Sage Publications, 1<sup>st</sup> Edition, 2005.
2. Barton, H., Grant, M., Guise, R., *Shaping Neighbourhoods: For Local Health and Global Sustainability*, Routledge Press, 2<sup>nd</sup> Edition, 2020.
3. <https://nptel.ac.in/courses/105/102/105102195/>
4. <https://nptel.ac.in/courses/124/107/124107011/>

**IV B.Tech. - I Semester**  
**(19BT70117) ENVIRONMENTAL ECONOMICS**

| Int. Marks | Ext. Marks | Total | L | T | P | C |
|------------|------------|-------|---|---|---|---|
| 40         | 60         | 100   | 3 | - | - | 3 |

**PREREQUISITES:** Courses on Environmental Science & Sustainable Engineering.

**COURSE DESCRIPTION:** Fundamentals of environmental economics; Economy and the natural environment interaction; Economic development and environment; Valuation of environmental goods and services; Sustainable economic development.

**COURSE OUTCOMES:** After successful completion of this course, the students will able to:

- CO1 Analyze fundamentals of environmental economics to solve environmental economics challenges associated with sustainable design of technology systems considering latest developments, society, environment, economic, and sustainability besides communicating effectively in graphical form.
- CO2 Analyze economy and the natural environment interaction to solve ecological limits and scarcity of eco-services approaches using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.
- CO3 Analyze economic development and environment to solve environmental cost-benefit challenges using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.
- CO4 Analyze valuation of environmental goods and services to solve methodical challenges using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.
- CO5 Analyze sustainable economic development to solve environmental economics challenges using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT – I: FUNDAMENTALS OF ENVIRONMENTAL ECONOMICS (10 Periods)**

Fundamentals of environmental economics, Review of microeconomics and welfare economics, Ecology-economy interaction, Perspective of economic modeling- the concept and conditions of sustainability of the human economy, Classification and characterization of resources and pollution as a public good or bad, Role of Externalities as the fundamental determinants, Property Rights, Market, Spatial-temporal dimensions of externality- command and control, Market approaches, Green tax, Taxes in controlling externalities

**UNIT - II: ECONOMY AND THE NATURAL ENVIRONMENT INTERACTION**

**(08 Periods)**

An overview of the economy and the natural environment; Interaction using an input-output based general equilibrium approach to show how ecological limits and scarcity of

eco-services would affect the resource allocation and prices; Regimes of natural resources, Types of goods, Provision of public goods.

### **UNIT – III: ECONOMIC DEVELOPMENT AND ENVIRONMENT (09 Periods)**

The relation between development environmental Quality - Environmental Kuznets curve; Development vs conservation of environmental resources - Ecosystem flips and irreversibility - Krutilla-Fisher equation; Environmental cost-benefit analysis under strong and weak conditions of sustainability; Choice of time discount rate for evaluation - Sustainability premium.

### **UNIT – IV: VALUATION OF ENVIRONMENTAL GOODS AND SERVICES**

**(10 Periods)**

Theory of environmental valuation and conceptual basis of its methods - Compensating variations and surplus, Equivalent variations and surplus, Willingness to pay or accept for improvement or loss of environmental goods and services; Empirical approaches in environmental valuation; Indirect methods of environmental valuation, Non-demand function methods of valuation, Revealed preference methods - (a) Hedonic Pricing, (b) Household production function approach, Defensive cost, Health cost and travel cost methods; The direct method of environmental valuation - Stated preference - Contingent valuation method.

### **UNIT – V: SUSTAINABLE ECONOMIC DEVELOPMENT**

**(08 Periods)**

Capital theoretic basis of the notion of sustainable development - Sustainable Development as non-declining intertemporal utility or that of the value of the wealth. Concepts of Genuine investment or savings, Green National Income, Natural capital stock and sustainable resource accounting, Strong and weak sustainability, Environmental adjustment of national income.

**Total Periods: 45**

**Topics for self-study are included in the lesson plan.**

#### **TEXT BOOKS:**

1. Siebert, H. and Siebert, H., *Economics of the Environment*. Massachusetts: Lexington Books, 9<sup>th</sup> Edition, 1981.
2. Pearce, David W., and Kerry Turner R., *Economics of Natural Resources and The Environment*, JHU Press, Revised and Enlarged Edition, 1990.

#### **REFERENCE BOOKS:**

1. Nick Hanley, Jason F Shorgen and Ben White, *Environmental Economics Theory and Practice*, MacMillan, 2<sup>nd</sup> Edition, 2006.
2. Tietenberg, Tom and Lynne Lewis, *Environmental and Natural Resource Economics*, Routledge, 11<sup>th</sup> Edition, 2018.
3. Kumar, P., *The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations*, Routledge, 2012.

#### **ADDITIONAL LEARNING RESOURCES:**

1. Field, C., *Environmental Economics: An Introduction*, McGraw-Hill Book Company (UK) Ltd, 8<sup>th</sup> Edition, 2021.
2. Sengupta, R., *Ecological Limits and Economic Development*, OUP Catalogue, 2013.

**IV B.Tech. - I Semester**  
**(19BT70118) SUSTAINABLE CITIES**

| Int. Marks | Ext. Marks | Total Marks | L | T | P | C |
|------------|------------|-------------|---|---|---|---|
| 40         | 60         | 100         | 3 | - | - | 3 |

**PRE-REQUISITES:** Courses on Environmental Science & Sustainable Engineering.

**COURSE DESCRIPTION:** Sustainability and urban development; Functions of cities; Inclusive, Safe and productive cities; Sustainable urban services and infrastructure; Governing sustainable cities.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1 Analyze sustainability and urban development to solve problems associated with cities using appropriate tools and techniques following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO2 Analyze city functioning for sustainability to solve problems associated with cities using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO3 Analyze inclusiveness, safety and productivity in cities to solve problems associated with cities using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO4 Analyze sustainable urban services and infrastructure to solve problems associated with cities using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.
- CO5 Analyze governance for sustainable cities to solve problems associated with cities using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT - I: SUSTAINABILITY AND URBAN DEVELOPMENT (08 Periods)**

The urban opportunity; Cities - Cultural and social transformation; Challenge of urban politics, Planning and governance, Urban research methods, Urban theory and history, Urban development and the environment, Urban growth and the environment - Why cities grow?, Externalities and the environment, Urban economic restructuring, City size and settlement planning.

**UNIT - II: FUNCTIONS OF CITIES (09 Periods)**

Understanding urban systems, Municipal, Regional and national governance, Urban utilities, Urban public finance and taxation; Law, order and conflict; Land management and planning, Lessons from London and Mumbai.

**UNIT - III: INCLUSIVE, SAFE AND PRODUCTIVE CITIES (10 Periods)**

What is urban poverty?, Measuring urban poverty, Poverty reduction in cities, Affordable and adequate housing, Who can deliver the housing we need?, Safety and violence, Urban vulnerabilities; Making cities productive and reduce inequality- City production

and consumption, Women in the informal economy, Migration, mobility and the urban-rural continuum Wealth and inequality, Case: SEWA, India, Migration and the refugee crisis; Improving human development in cities – Addressing the challenges of urban public health, Solutions for improving urban health, Education and skills, Higher education in cities, Gender in the city, Human rights and justice, Law and equality, Apartheid in South African cities.

#### **UNIT - IV: SUSTAINABLE URBAN SERVICES AND INFRASTRUCTURE (08 Periods)**

Sustainable environmental services and infrastructure, Sustainable transport planning, ICT, Sustainable urban energy systems, Sustainable transport: Bangkok; How can cities be resilient -Air, water, food and natural resources; City risk exposure; Climate impacts, adaptation and mitigation; Building urban resilience, Environmental planning and the politics of change.

#### **UNIT - V: GOVERNING SUSTAINABLE CITIES (10 Periods)**

Sustainable environmental practices, Urban disaster risk management, Post-disaster recovery, SDGs and other global processes, New institutions and governance, Public participation and democracy, Financing sustainable development, Measuring and monitoring the SDGs, Opportunities of secondary cities.

**Total Periods: 45**

***Topics for self-study are included in the lesson plan.***

#### **TEXT BOOKS:**

1. Al-Zu'bi, Maha, and Vesela Radovic, *SDG11-Sustainable Cities and Communities: Towards Inclusive, Safe, and Resilient Settlements*, Emerald Group Publishing, 1<sup>st</sup> Edition, 2019.
2. Rydin, Yvonne, *Governing for Sustainable Urban Development*, Earthscan, 2012.
3. Evans, Bob, Marko Joas, Susan Sundback, and Kate Theobald, *Governing Sustainable Cities*, Routledge, 2013.

#### **REFERENCE BOOKS:**

1. Register, R., *EcoCities: Rebuilding Cities in Balance with Nature*, New Society Publishers, Revised Edition, 2006.
2. Yigitcanlar, T, *Sustainable Urban and Regional Infrastructure Development: Technologies, Applications and Management: Technologies, Applications and Management*, IGI Global, 2007.

#### **ADDITIONAL LEARNING RESOURCES:**

1. Flint J. and Raco M., *The Future of Sustainable Cities: Critical Reflections*, Policy Press, 2<sup>nd</sup> Edition, 2012.
2. Corburn, J., *Toward the Healthy City: People, Places and the Politics of Urban Planning*, MIT Press, 3<sup>rd</sup> Edition, 2009.

**IV B.Tech. - I Semester**  
**(19BT70119)SUSTAINABLE DESIGN OF TECHNOLOGY SYSTEMS**

| Int. Marks | Ext. Marks | Total Marks | L | T  | P  | C |
|------------|------------|-------------|---|----|----|---|
| 40         | 60         | 100         | 3 | -- | -- | 3 |

**PRE-REQUISITES:** Courses on Environmental Science & Sustainable Engineering.

**COURSE DESCRIPTION:** Sustainability and sustainable development; Product life cycle design – Methods and strategies; Product life cycle design – Software tools; Designing for sustainable product-service system – Methods and tools; Design for sustainability – Engineering design criteria and guidelines.

**COURSE OUTCOMES:** After successful completion of this course, the students will be able to:

- CO1 Analyze sustainability and sustainable development to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.
- CO2 Analyze product life cycle design methods and strategies to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.
- CO3 Analyze product life cycle design software tools to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.
- CO4 Design sustainable product-service systems to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.
- CO5 Design engineering criteria and guidelines to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

**DETAILED SYLLABUS:**

**UNIT - I: SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT (09 Periods)**

Sustainability and sustainable development - Understanding un-sustainability and need for Sustainability, Definitions, Pathway, Systems approach to design; Evolution of sustainability within design - Diverse approaches to design for sustainability, Relationship between approaches to design for sustainability and the application context.

**UNIT - II: PRODUCT LIFE CYCLE DESIGN – METHODS AND STRATEGIES**

**(08 Periods)**

Life Cycle Assessment (LCA) - Product Life Cycle Assessment, LCA introduction, LCA methodology, LCA goal, LCA scope, Inventory analysis, Impact assessment,

Interpretation; Environmental risk, Environmental impacts calculation by using LCA technique, Risk assessment with concepts of LCA.

**UNIT - III: PRODUCT LIFE CYCLE DESIGN – SOFTWARE TOOLS (08 Periods)**

History of product design by LCA with examples; ISO 14000, Life cycle analysis, SIMA PRO, LCA software and other software for LCA, LCA methodical challenges - Allocation and uncertainty, Sensitivity analysis.

**UNIT - IV: DESIGNING FOR SUSTAINABLE PRODUCT-SERVICE SYSTEM – METHODS AND TOOLS (10 Periods)**

Sustainable product service system design – Definition, Types and examples; Sustainable product service system – Transition path and challenges, Sufficiency economy philosophy applied to sustainable product-service system (PSS) thinking, Khadi movement as a precursor to PSS thinking.

**UNIT - V: DESIGN FOR SUSTAINABILITY – ENGINEERING DESIGN CRITERIA AND GUIDELINES (09 Periods)**

Sustainable product-service system design applied to distributed economy, Other design for sustainability tools and approaches – Agriculture, Cities and communities, Carbon footprint, Green buildings, Green materials, Green energy, Sustainable development, Zero waste, Circular economy.

**Total Periods: 45**

***Topics for self-study are provided in the lesson plan.***

**TEXT BOOKS:**

1. Horne, Ralph, Tim Grant, and Karli Verghese, *Life Cycle Assessment: Principles, Practice and Prospects*, Csiro Publishing, 2009.
2. Bhamra, Tracy, and Vicky Lofthouse, *Design For Sustainability: A Practical Approach*. Routledge, 1<sup>st</sup> Edition, 2016.

**REFERENCE BOOKS:**

1. Vezzoli, C., Kohtala, C., Srinivasan, A., Diehl, J. C, Fusakul, S. M., Xin, L. and Sateesh, D., *Product-service System Design for Sustainability*, Routledge, 1<sup>st</sup> Edition, 2017.
2. Curran, Mary Ann, *Life Cycle Assessment Student Handbook*, John Wiley & Sons, 1<sup>st</sup> Edition, 2015.
3. Hauschild, Michael Z., Ralph K. Rosenbaum and Stig Irvin Olsen, *Life Cycle Assessment*, Springer International Publishing, 2018.
4. Hendrickson, Chris T., Lester B. Lave, and H. Scott Matthews, *Environmental Life Cycle Assessment of Goods and Services: An Input-Output Approach*. Routledge, 2010.

**ADDITIONAL LEARNING RESOURCES:**

1. Sharmistha Banerjee, *System Design for Sustainability*, IIT Guwahati, <https://nptel.ac.in/courses/107/103/107103081/>.
2. Curran, Mary Ann, *Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products*, John Wiley & Sons, 3<sup>rd</sup> Edition, 2012.