ACADEMIC REGULATIONS
COURSE STRUCTURE
AND
DETAILED SYLLABI

OF

ELECTRONICS AND INSTRUMENTATION 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 INSTRUMENTATION ENGINEERING

VISION

To become a centre of excellence in creative learning and research in the field of Electronics and Instrumentation

MISSION

- Offer comprehensive and rigorous educational program in the domain of Electronics and Instrumentation and to prepare students ready for industry & research.
- Design, develop and disseminate contemporary curriculum with knowledge and skills in the fields of Control and Instrumentation to match the expectations of real time needs.
- Establish an ambient and object oriented development ecosystem for a diversity of faculty and students to foster holistic development.
- Create world class infrastructure for teaching, learning, training and research to achieve highest order of excellence in designing systems and controllers.
- Inculcate zeal for ethics among faculty, staff and students to develop creativity and innovation with value.

PROGRAM EDUCATIONAL OBJECTIVES

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

1. Enrolled or completed higher education in the core or allied areas of electronics and instrumentation engineering or management.
2. Successful career in electronics and instrumentation enabled industries or software industries or be an entrepreneur in the domain area.
3. Constantly enhanced their knowledge on new developments in the core or allied areas of electronics and instrumentation engineering.

PROGRAM OUTCOMES

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

PSO1. Identify and apply suitable sensors and measuring instruments to acquire process variable to analyze the behavior of the system.

PSO2. Analyze, design and implement electronic systems for processing the signals for efficient and smart systems.

PSO3. Design controllers with domain specific tools and technologies for customized solutions.

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 MaximumDuration:

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.

<table>
<tr><th>Sl. No.</th><th>Course</th><th>Marks</th><th colspan="2">Examination and Evaluation</th><th>Scheme of examination</th></tr>
<tr><td rowspan="3">1.</td><td rowspan="3">Theory</td><td>60</td><td colspan="2">Semester-end examination for 3 hours duration (External evaluation)</td><td>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.</td></tr>
<tr><td rowspan="2">40</td><td>10</td><td>Assignments (Internal evaluation).</td><td>One Assignment shall be given to the student for 10 marks during the semester and Assignment Marks finalized.</td></tr>
<tr><td>30</td><td>Mid-term Examination of 2 hours duration (Internal evaluation).</td><td>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.
Mid-I: After first spell of instruction (I & II Units).
Mid-II: 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.</td></tr>
<tr><td>2.</td><td>Laboratory</td><td>50</td><td colspan="2">Semester-end Lab Examination for 3 hours duration (External evaluation)</td><td>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.</td></tr>
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Sl. No.	Course	Marks	Examination and Evaluation		Scheme of examination
		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. **Laboratory examination-I:** Shall be conducted just before FIRST mid-term examinations. **Laboratory examination-II:** Shall be conducted just before SECOND mid-term examinations.
			20	Practical test (Internal evaluation).	
3.	Internship	100	Semester-end Examination		The evaluation shall be done by the Department Evaluation Committee (**DEC**) at the end of the semester as given in 12.2.1.
4.	Open Elective (MOOC)	100	-		Thestudent 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 in10.4.
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 (**PEC)** 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
For Mandatory Courses			
>=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:

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

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:

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

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

CGPA	Division
> = 7.0	First Class with Distinction
> = 6.0 and < 7.0	First Class
> = 5.0 and < 6.0	Second Class
> = 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
	If the candidate:	
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 or answer book or additional sheet, during	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

	or after the examination.	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 INSTRUMENTATION ENGINEERING

Mandatory Induction Program	03 weeks duration
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 INSTRUMENTATION 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
		Total:	**14**	**1**	**6**	**21**	**18**	**350**	**450**	**800**
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
		Total:	**15**	**4**	**10**	**29**	**24**	**450**	**550**	**1000**

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.	19BT30402	Electronic Devices and Circuits	3	-	-	3	3	40	60	100
3.	19BT30404	Switching Theory and Logic Design	3	-	-	3	3	40	60	100
4.	19BT31001	Electrical and Electronic Measurements	3	1	-	4	4	40	60	100
5.	19BT31002	Transducers in Instrumentation	3	-	-	3	3	40	60	100
6.	19BT3HS31	Soft Skills Lab	-	-	2	2	1	50	50	100
7.	19BT30432	Electronic Devices and Circuits Lab	-	-	2	2	1	50	50	100
8.	19BT31031	Instrumentation Workshop	-	-	2	2	1	50	50	100
9.	19BT31032	Measurements and Transducers Lab	-	-	2	2	1	50	50	100
		Total:	**15**	**2**	**8**	**25**	**21**	**400**	**500**	**900**
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.	19BT30403	Signals and Systems	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.	19BT41001	Industrial Instrumentation	3	-	-	3	3	40	60	100
6.	**Open Elective – 1**		3	-	-	3	3	40	60	100
7.	19BT40432	Electronic Circuit Analysis and Design Lab	-	-	2	2	1	50	50	100
8.	19BT40433	Linear and Digital IC Applications Lab	-	-	2	2	1	50	50	100
9.	19BT41031	Industrial Instrumentation Lab	-	-	2	2	1	50	50	100
		Total:	**18**	**1**	**6**	**25**	**22**	**390**	**510**	**900**
10.	19BT315AC	Design Thinking	2	-	-	2	-	-	-	-

III B.Tech. – I Semester

<table>
<tr><th rowspan="2">Sl. No.</th><th rowspan="2">Subject Code</th><th rowspan="2">Course Title</th><th colspan="4">Contact Periods per week</th><th rowspan="2">C</th><th colspan="3">Scheme of Examination Max. Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>Total</th><th>Int. Marks</th><th>Ext. Marks</th><th>Total Marks</th></tr>
<tr><td>1.</td><td>19BT50402</td><td>Digital Signal Processing</td><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>2.</td><td>19BT50442</td><td>Principles of Communications</td><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>3.</td><td>19BT50207</td><td>Computer Organization and Architecture</td><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="3">Professional Elective-1</td><td rowspan="5">3</td><td rowspan="5">-</td><td rowspan="5">-</td><td rowspan="5">3</td><td rowspan="5">3</td><td rowspan="5">40</td><td rowspan="5">60</td><td rowspan="5">100</td></tr>
<tr><td rowspan="4">4.</td><td>19BT50403</td><td>VLSI Design</td></tr>
<tr><td>19BT40501</td><td>Computer Networks</td></tr>
<tr><td>19BT51001</td><td>Optoelectronics and Laser Instrumentation</td></tr>
<tr><td>19BT51002</td><td>Intelligent Control</td></tr>
<tr><td>5.</td><td colspan="2">Open Elective-2</td><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="3">Inter Disciplinary Elective-1</td><td rowspan="5">3</td><td rowspan="5">-</td><td rowspan="5">-</td><td rowspan="5">3</td><td rowspan="5">3</td><td rowspan="5">40</td><td rowspan="5">60</td><td rowspan="5">100</td></tr>
<tr><td rowspan="4">6.</td><td>19BT50341</td><td>Industrial Safety and Maintenance Engineering</td></tr>
<tr><td>19BT50343</td><td>Thermodynamics and Fluid Mechanics</td></tr>
<tr><td>19BT50502</td><td>Artificial Intelligence</td></tr>
<tr><td>19BT21501</td><td>Object Oriented Programming Through Java</td></tr>
<tr><td>7.</td><td>19BT61531</td><td>Internet of Things Lab</td><td>-</td><td>1</td><td>2</td><td>3</td><td>2</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>8.</td><td>19BT51031</td><td>Signal Processing Lab</td><td>-</td><td>-</td><td>2</td><td>2</td><td>1</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>9.</td><td>19BT51032</td><td>Socially Relevant Project-I</td><td>-</td><td>-</td><td>-</td><td>-</td><td>1</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td colspan="3">Total:</td><td>18</td><td>1</td><td>4</td><td>23</td><td>22</td><td>390</td><td>510</td><td>900</td></tr>
<tr><td>10.</td><td>19BT503AC</td><td>Foundations of Entrepreneurship</td><td>2</td><td>-</td><td>-</td><td>2</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

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.	19BT60402	Microcontrollers	3	-	-	3	3	40	60	100
3.	19BT61001	Process Control Instrumentation	3	-	-	3	3	40	60	100
Professional Elective-2										
4.	19BT60203	Advanced Control Systems	3	-	-	3	3	40	60	100
	19BT50406	FPGA Architectures and Applications								
	19BT61002	Analytical Instrumentation								
	19BT61003	Industrial Data Communications								
Professional Elective-3										
5.	19BT50342	Robotics and Automation	3	-	-	3	3	40	60	100
	19BT60405	Digital IC Design								
	19BT60407	Image Processing								
	19BT61004	Power Plant Instrumentation								
Inter Disciplinary Elective-2										
6.	19BT60201	Power Electronics	3	-	-	3	3	40	60	100
	19BT60241	Renewable Energy Sources								
	19BT60341	Biomechanics								
	19BT60502	Machine Learning								
7.	19BT60432	Microcontrollers Lab	-	-	2	2	1	50	50	100
8.	19BT61031	Process Control Lab	-	-	2	2	1	50	50	100
9.	19BT61032	Socially Relevant Project-II	-	-	-	-	1	50	50	100
		Total:	**18**	**0**	**4**	**22**	**21**	**390**	**510**	**900**
10.	19BT5MC01	Universal Human Values	2	-	-	2	-	40	-	40

IV B.Tech. – I Semester

<table>
<tr><th rowspan="2">Sl. No.</th><th rowspan="2">Subject Code</th><th rowspan="2">Course Title</th><th colspan="4">Contact Periods per week</th><th rowspan="2">C</th><th colspan="3">Scheme of Examination Max. Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>Total</th><th>Int. Marks</th><th>Ext. Marks</th><th>Total Marks</th></tr>
<tr><td>1.</td><td>19BT6HS02</td><td>Organizational Behavior</td><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>2.</td><td>19BT71001</td><td>Biomedical Instrumentation</td><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>3.</td><td>19BT71002</td><td>Programmable Logic Controller</td><td>3</td><td>-</td><td>-</td><td>3</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="3">Professional Elective–4</td><td rowspan="5">3</td><td rowspan="5">-</td><td rowspan="5">-</td><td rowspan="5">3</td><td rowspan="5">3</td><td rowspan="5">40</td><td rowspan="5">60</td><td rowspan="5">100</td></tr>
<tr><td rowspan="4">4.</td><td>19BT70401</td><td>Embedded Systems</td></tr>
<tr><td>19BT60410</td><td>Wireless Sensor Networks</td></tr>
<tr><td>19BT71003</td><td>Aircraft Instrumentation</td></tr>
<tr><td>19BT71004</td><td>Computer Control of Processes</td></tr>
<tr><td colspan="3">Professional Elective–5</td><td rowspan="5">3</td><td rowspan="5">-</td><td rowspan="5">-</td><td rowspan="5">3</td><td rowspan="5">3</td><td rowspan="5">40</td><td rowspan="5">60</td><td rowspan="5">100</td></tr>
<tr><td rowspan="4">5.</td><td>19BT60403</td><td>Advanced Digital Signal Processing</td></tr>
<tr><td>19BT71005</td><td>Instrumentation in Process Industries</td></tr>
<tr><td>19BT71006</td><td>Identification and Adaptive Control</td></tr>
<tr><td>19BT71007</td><td>Biomedical Signal Processing</td></tr>
<tr><td>6.</td><td>19BT7MOOC</td><td>MOOC</td><td>-</td><td>-</td><td>-</td><td>-</td><td>3</td><td>-</td><td>100</td><td>100</td></tr>
<tr><td>7.</td><td>19BT71031</td><td>Biomedical Instrumentation Lab</td><td>-</td><td>-</td><td>2</td><td>2</td><td>1</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>8.</td><td>19BT71032</td><td>Industrial Automation Lab</td><td>-</td><td>-</td><td>2</td><td>2</td><td>1</td><td>50</td><td>50</td><td>100</td></tr>
<tr><td>9.</td><td>19BT71033</td><td>Internship</td><td>-</td><td>-</td><td>-</td><td>-</td><td>2</td><td>-</td><td>100</td><td>100</td></tr>
<tr><td colspan="3">Total:</td><td>15</td><td>-</td><td>4</td><td>19</td><td>22</td><td>300</td><td>600</td><td>900</td></tr>
<tr><td>10.</td><td>19BT710AC</td><td>Process Plant Layout and Piping Design</td><td>2</td><td>-</td><td>-</td><td>2</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

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.	19BT81031	Project Work	-	-	-	-	10	100	100	200
		Total:	**-**	**-**	**-**	**-**	**10**	**100**	**100**	**200**

LIST OF COURSES FOR
OPEN ELECTIVE–1 and OPEN ELECTIVE-2

Course Code	Open Elective -1	Course Code	Open Elective -2
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 has undergone additional learning for 18 credits in the same discipline.

HONORS DEGREE IN ELECTRONICS AND INSTRUMENTATION 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)	19BT51003	Advanced Sensors	3	-	-	3	40	60	100
	19BT51004	Wearable sensors and its application	3	-	-	3	40	60	100
	19BT51005	Digital Control Systems	3	-	-	3	40	60	100
	19BT51006	Sensors and Actuators	3	-	-	3	40	60	100
III B.Tech II-Sem. (2 Theory)	19BT61005	Smart sensors	3	-	-	3	40	60	100
	19BT61006	Fractional Calculus and Control	3	-	-	3	40	60	100
	19BT61007	MEMS Technology	3	-	-	3	40	60	100
	19BT61008	Multisensor data fusion	3	-	-	3	40	60	100
IV B.Tech I-Sem. (2 Theory)	19BT71008	Sensors for structural health monitoring	3	-	-	3	40	60	100
	19BT71009	Wearable technology and IOT	3	-	-	3	40	60	100
	19BT71010	Robust & Optimal Control	3	-	-	3	40	60	100
	19BT71011	Telemetry and Telecontrol	3	-	-	3	40	60	100

Minor Degree: Minor degree is awarded to the students who has 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 EEE, ECE, EIE, CE, ME, 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, 13th edition, 2014.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.

REFERENCE BOOKS:

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

I B. Tech - I Semester

(19BT1BS02) **BIOLOGY FOR ENGINEERS**

(Common to ECE, EEE 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, GauravAgarwal, *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, 6th 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 ECE, EEE 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, 11th edition, 2019.
2. P. K. Palaniswamy,*Engineering Physics*, Scitech Publications India Private Limited, 2nd 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*, DhanpatRai Publications (P) Ltd, 2015.

I B. Tech. – I Semester

(19BT10341) BASIC CIVIL AND MECHANICAL ENGINEERING

(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: 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

TEXT BOOKS:

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

REFERENCE BOOKS:

1. Seetharaman S., *Basic Civil Engineering*, Anuradha Agencies, 2005.
2. Ramamrutham S., *Basic Civil Engineering*, DhanpatRai Publishing Co.(P) Ltd.1999.
3. Kalpakjian, Serope, *Manufacturing Engineering and Technology,* Pearson Education, 7th 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, 1st 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. AshfaqHussain*, Fundamentals of Electrical Engineering,* Dhanpatrai & Co. (P) Ltd., *3*rd edition, 2009.
2. R. L. Boylestad and Louis Nashelsky, *Electronics Devices and Circuits*, PHI, 11th 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., 4th edition, 2011.

I B. Tech. - I Semester

(19BT1BS31) **ENGINEERING PHYSICS LAB**

(Common to ECE, EEE 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.

REFERENCE BOOKS:

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 ECE, EEE 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. YannisTsividis, *A First Lab in Circuits and Electronics*, Wiley, 1st edition., 2001

ADDITIONAL LEARNING RESOURCES:

1. www.vlab.co.in, Virtual Electric Circuits Lab, A initiative of MHRD under NMEICT.
2. 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 ECE, EEE 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.

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:

7. Fabricate a rectangular tray as per the dimensions
8. Fabricate square vessel/cylinder as per the dimensions
9. 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:

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

DEMONSTRATION:

12. Demonstrate the dismantling and assembling of various two wheeler parts
13. Demonstrate the usage of power tools.
14. Demonstrate the plumbing operation and identify the essential tool and materials required for plumbing.
15. 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, 17th edition, 2012.
2. Kalpakjian, Serope, *Manufacturing Engineering and Technology*, Pearson Education, 7th edition, 2014.

I B. Tech. – I Semester

(19BT1AC01) **SPOKEN ENGLISH**

(Common to ECE, EEE and EIE)

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

PRE-REQUISITES: -

COURSE DESCRIPTON: 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 expressing abilities, agreements/disagreements and asking/giving advice, directions, information etc.

CO2. Understand the contextual vocabulary, British/American spelling, technical jargon and apply them for day-to-day conversations in formal/informal situations.

CO3. Communicate effectively in formal/informal situations by demonstrating, examining and applying appropriate tenses, voice, conversational and narrating techniques.

DETAILED SYLLABUS:

UNIT-I: FUNCTIONAL ENGLISH: (06 Periods)

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

UNIT-II: VOCABULARY BUILDING (06 Periods)

Introduction: Vocabulary for day-to-day conversations; 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)

Parts of Speech, Verb forms; Tenses; Voice; Speech.

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

Universal Auxiliaries; 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 expressions; Good Manners and Etiquette; Conversation Techniques; Narrating 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 BhaskerRaju, *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**

(EEE, ECE, EIE, CE, ME, 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, 10th edition, 2016.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.
3. David Poole, *Linear Algebra: A Modern Introduction*, Brooks/Cole, 2nd edition, 2005.

REFERENCE BOOKS:

1. B. V. Ramana, *Higher Engineering Mathematics*, Tata McGraw hill, 1st 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 ECE, EEE 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 Ψ and Ψ^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; Π-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*, DhanpatRai Publishing Company (P) Ltd, New Delhi, 16th 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, 5th edition 2010.
2. Skoog and West, *Principles of Instrumental Analysis*, Thomson, 6th edition, 2007.
3. Peter Atkins, Julio de Paula and James Keelar, *Atkins' Physical Chemistry*, Oxford University Press, 10th edition, 2010.

I B. Tech – II Semester

(19BT1HS01) COMMUNICATIVE ENGLISH

(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: 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. Analyze the modes and techniques of listening, speaking, reading, writing and apply appropriately to communicate effectively with the engineering community and society.

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: 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 ECE, EEE 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. Develop and use Python modules to provide solutions to 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. NageswaraRao, *Core Python Programming,* 2nd edition, Dreamtech Press, 2018.
2. R. G. Dromey, *How to solve i*t by Computer,* Pearson, 2006.

REFERENCE BOOKS:

1. ReemaThareja, *Python Programming using Problem Solving Approach*, 1st 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 for 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^{th} edition, McGraw Hill Education (India) Private Limited, NewDelhi, 2013.
2. A. Sudhakar, Shyammohan S Palli, *Circuits and Networks Analysis and Synthesis*, 5^{th} edition, McGraw Hill Education (India) Private Limited, NewDelhi, 2015.

REFERENCE BOOKS:

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

List of Experiments:

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

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^H 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 ECE, EEE 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. Function effectively as an individual and as a member in diverse teams analyzing the situations and applying appropriate listening, speaking, reading, writing skills to communicate effectively with the engineering community and society.

List of Exercises:

First Ten exercises are mandatory among the following:

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 ECE, EEE 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, Involutes.

Exercises:

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

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, 51st 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, 4th edition, 2012.

I B. Tech. – II Semester

(19BT10531) PROGRAMMING FOR PROBLEM SOLVING LAB

(Common to ECE, EEE 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.

Consumption units	**Rate (in Rupees/Unit)**
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*, Dreamtech Press, 2nd edition, 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. YannisTsividis, *A First Lab in Circuits and Electronics*, Wiley, 1st edition, 2001.

ADDITIONAL LEARNING RESOURCES:

1. 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, 9th edition, 2012.
2. B. S. Grewal, *Higher Engineering Mathematics*, Khanna publishers, 44th edition, 2017.

REFERENCE BOOKS:

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

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

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 circuit analysis, comparison of BJT & FET.

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

Tunnel Diode, Varactor Diode, Uni Junction 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 Suryaprakash Rao Mothiki, *Pulse Digital and Switching Waveforms,* TMH, 3rd edition, 2011.
2. J. Millman, Christos C. Halkias and SatyabrataJit, *Electronic Devices and Circuits*, TMH, 3rd Edition, 2010.

REFERENCE BOOKS:

1. David A. Bell, *Electronic Devices and Circuits*, Oxford University press, 5th Edition, 2014
2. S. Salivahanan, N. Suresh Kumar, *Electronic Devices and Circuits*, TMH, 3rd Edition 2013.
3. R.L. Boylestad and Louis Nashelky, *Electronic Devices and Circuits*, PHI, 10th 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
3. http://www.talkingelectronics.com/Download%20eBooks/Principles%20of%20electronics/CH-21.pdf

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: A course on Transformation Techniques and Linear algebra.

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,5th edition, 2017.

REFERENCE BOOKS:

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

II B. Tech – I Semester

(19BT31001) ELECTRICAL AND ELECTRONIC MEASUREMENTS

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

PRE-REQUISITES: A course on Network Analysis

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 BOOKS:

1. A.K.Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, New Delhi, 19th Revised edition, 2013.
2. H S Kalsi, *Electronic Instrumentation and Measurements*, McGraw-Hill, 4th edition, 2019.

REFERENCE BOOKS:

1. E.W. Golding & F.C. Widdis, *Electrical Measurements and Measuring Instruments*, 5th edition, Wheeler Publishing.
2. Doeblin, E.O., *Measurement Systems: Applications and Design*, McGraw-Hill, 4th edition 2003.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105153/
2. https://swayam.gov.in/nd1_noc19_ee44/preview

II B. Tech. – I Semester

(19BT31002) TRANSDUCERS IN INSTRUMENTATION

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

PRE-REQUISITES: Courses on Engineering Physics, Network Analysis

COURSE DESCRIPTION: Introduction to measuring instruments and characteristics of transducers; working principle of resistive, inductive, capacitive, self-generating and other sensors; applications of principles in sensors for measurement of Temperature, Torque, Velocity, Acceleration; Miscellaneous sensors.

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

- CO1. Demonstrate knowledge on static and dynamic characteristics of transducers and estimate the errors in the measuring instrument.
- CO2. Demonstrate the working principle of various sensors and its applications.
- CO3. Analyze different temperature measuring transducers and develop measuring circuits to solve problems.
- CO4. Analyze and measure torque, velocity and acceleration by applying different sensing techniques and transducers to solve problems.

DETAILED SYLLABUS:

UNIT – I: MEASUREMENT & CHARACTERISTICS OF TRANSDUCERS (09 Periods)

Elements of a Generalized Measurement System, Errors: Relative Error, Limiting Error, Types of Errors, Statistical measurement of errors: Mean, Median, Standard Deviation, Normal Distribution; Transducer Principle, Classification of transducers, Static Characteristics of transducers: Accuracy, Precision, Threshold, Resolution, Sensitivity, Linearity, Hysteresis, Dead Space, Repeatability, Reproducibility, Span and Calibration. Dynamic characteristics of transducers: Fidelity, Measuring Lag, Dynamic Error, Speed of Response.

UNIT – II: MEASUREMENT PRINCIPLES (10 Periods)

Resistive Sensor: Potentiometer, Strain gauges& its types. Capacitive Sensors: Change in overlapping area, dielectric constant and distance between the plates. Inductive sensors: Variable reluctance, Eddy current, Linear variable differential transformers, Hall Effect. Piezoelectric sensors, Ultrasonic sensor: Attenuation, Transit time, Doppler effect;

UNIT – III: TEMPERATURE MEASUREMENT (09 Periods)

Temperature measurement: Change in physical properties – Solid expansion type, Fluid expansion type (Filled-in system), Resistance temperature detector (RTD), principle, types, Measuring circuits: 3-Lead & 4-Lead arrangement. Thermistors principle and types, linearization methods, Thermocouples: thermoelectric effects, Laws, Thermoelectric characteristics of thermocouple, types, measuring circuits, Cold junction Compensation, IC temperature sensors - Diodes, Transistors, Temperature switches, thermostats, Radiation measurement: Introduction, types: Radiation & Infrared Pyrometers; Analysis and selection of Temperature sensors.

UNIT – IV: TORQUE, VELOCITY & ACCELERATION (09 Periods)

Torque Measurement: Load cell method, Strain gauge method, Weidman Magentostrictive, Digital Methods. Velocity Measurement: Electromagnetic Type, Tachometers, Stroboscope. Acceleration Measurement: Reluctance type, Potentiometric type, piezoelectric type, Null Balance. Comparison, Analysis and selection of different Torque, Velocity and Acceleration sensors.

UNIT – V: MISCELLENEOUS SENSORS (08 Periods)

Gyroscopes: Principle, Single axis Restrained Gyro and Two axis free Gyro, Three axis Gyro, Vibration Sensors, magneto diodes & magneto transistors, Resonant Sensors: force, temperature, angular velocity; SAW Sensors, Encoders: Incremental & absolute. SMART sensors.

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. Ramon Pallás Areny, John G. Webster, *Sensors and Signal Conditioning*, John Wiley and Sons, 2nd Edition, 2000.

REFERENCE BOOKS:

1. Ernest Doebelin, Dhanesh Manik, *Measurement Systems*, McGraw Hill International, 6th Edition, 2011.
2. Bela G Liptak, *Instrument Engineers' Handbook: Process Measurement and Analysis*, CRC Press - Butterworth Heinemann, 4th Edition, 2003.
3. A. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, 19th 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
3. https://www.ibiblio.org/kuphaldt/socratic/sinst/book/liii.pdf

II B. Tech. – I Semester

(19BT3HS31) SOFT SKILLS LAB

(Common to ECE, EEE 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.

List of Exercises:
First TEN exercises are mandatory among the following:

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 – Intitutive 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 – Dinning Etiquette – Conference Etiquette

TEXT BOOK:

1. Soft Skills Lab Manual, SVEC.

REFERENCE BOOK:

1. R. C. Sharma & Krishna Mohan, *Business Correspondence and Report Writing*, Tata McGraw-Hill Publishing Company Limited, 3rd 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
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

(19BT30432) ELECTRONIC DEVICES AND CIRCUITS LAB

(Common to ECE, EEE 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 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*, PHI Learning Private Ltd, Vol.2, 6th Edition, 2018.

ADDITIONAL LEARNING RESOURCES:

1. www.vlab.co.in, Basic Electronics Lab, An initiative of MHRD under NMEICT.

II B. Tech. – I Semester

(19BT31031) **INSTRUMENTATION WORKSHOP**

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

PRE-REQUISITES: Courses on Basics of Electrical and Electronic Engineering, Network Analysis

COURSE DESCRIPTION: Test various instrumentation devices; measure the current, voltage and power; solder and de-solder the components; PCB design and electrical wiring diagram for instrument panel.

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

CO1. Demonstrate knowledge on testing of various components using measuring instruments.

CO2. Develop printed circuit boards for simple electronic circuits.

CO3. Calibrate voltmeters and ammeters for specified range.

CO4. Apply simulation tool to develop electronic circuits.

CO5. Design electric circuit wiring loop with IEEE Standards for the given application.

CO6. Work independently and in teams to solve problems with effective communication.

LIST OF EXPERIMENTS:

Minimum of TEN experiments are to be conducted.

1. Testing of resistors, capacitors, diode, Transistor, Different SCRs, Relay, and Contactors.
2. Measure voltage, time period and phase difference of a circuit using CRO.
3. Dismantle & assemble CRO and Function generator and identification of components present.
4. Calibration exercise for voltmeter and ammeter.
5. Design a printed circuit board for a given circuit.
6. Solder and de-solder electronic components on PCB as well solder earth connection.
7. Test pressure/flow/level/temperature switch.
8. Test proximity & limit switch.
9. Test assembled instrument loop wiring for various parameters and faults.

10. Introduction to surface mount device.
11. Introduction to an electronic design and simulation package.
12. Electric circuit wiring diagram using IEEE standard symbols for one instrument panel application.
13. Study of flow and level transmitters.

TEXTBOOKS:

1. K. Padmanabhan and P. Swaminathan, *Electronic Components*, Laxmi Publications, 2nd edition, 2006.
2. Thomas Petruzzellis, *Build Your Own Electronics Workshop,* McGraw-Hill, 2005
3. H S Kalsi, *Electronic Instrumentation and Measurements,* McGraw-Hill, 4th edition, 2019.
4. Curtis D. Johnson, *Process Control Instrumentation Technology*, Pearson Education Limited, 8th edition, 2013.

ADDITIONAL LEARNING RESOURCES:

1. http://www.instrumentationworld.com/instrumentation_tutorial.htm
2. http://www.pc-education.mcmaster.ca/Instrumentation/go_inst.htm

II B. Tech. – I Semester

(19BT31032) MEASUREMENTS AND TRANSDUCERS LAB

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

PRE-REQUISITES: Basics of Electrical and Electronic Engineering, Network Analysis

COURSE DESCRIPTION: Calibration of measuring instruments; Measurement of voltage, resistance, inductance, capacitance, displacement, pressure, temperature and weight; Design of AC/DC bridges.

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

CO1. Analyze the performance of instruments to measure voltage, current, resistance, inductance, capacitance and energy by calibrating the instruments.

CO2. Analyze the performance of sensors to measure temperature, displacement, acceleration, pressure and weight by calibrating the experimental setup.

CO3. Design and develop the appropriate circuit for measurement of voltage, current, resistance, Inductance and capacitance based on the application.

CO4. Work independently and in teams to solve problems with effective communication.

LIST OF EXPERIMENTS:

Minimum of TEN Experiments are to be conducted

1. Calibration of D’Arsonval Galvanometers for measurement of Voltage & Current.
2. Calibration of D’Arsonval Galvanometers for measurement of Resistance (shunt & Series).
3. Design of Wheatstone bridge and Kelvin Bridge for measurement of Resistance.
4. Design of Schering Bridge and De Sauty Bridge for measurement of Capacitance.
5. Design of Maxwell’s bridge and Andersons Bridge for measurement of Inductance.
6. Measurement of resistance, inductance, capacitance and quality factor of the coil using Q meter.
7. Measurement of energy using single phase energy meter.
8. Study and analyze the characteristics of capacitive transducer for measurement of angular displacement.
9. Calibration of LVDT for linear displacement measurement.
10. Study and analyze the characteristics of RTD sensor.

11. Study and analyze the characteristics of strain gauge.
12. Study and analyze the characteristics of bourdon tube.
13. Study and analyze the characteristics of piezoelectric sensor.

REFERENCE BOOKS/LABORATORY MANUALS:

1. A. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, New Delhi, 19thRevised Edition, 2013.
2. H.S. Kalsi, *Electronic Instrumentation*, TMH, 2002.

ADDITIONAL LEARNING RESOURCES:

1. https://www.youtube.com/watch?v=xLjk5DrScEU
2. http://sl-coep.vlabs.ac.in/
3. http://vlabs.iitkgp.ernet.in/asnm/#

II B. Tech. – I Semester
(19BT3MC02) ENVIRONMENTAL SCIENCE
(Common to ECE, EEE 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: ENVIRONMETAL 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. Anubha Kaushik and C. P. Kaushik, *Perspectives in Environmental Studies*, New Age International (P) Ltd. Publications, 6th Edition, 2018.
2. Erach Barucha, *Environmental Studies,* Orient Blackswan, 2nd Edition, 2013.

REFERENCE BOOKS:

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

ADDITIONAL LEARNING RESOURCES:

1. B. S. Chauhan, *Environmental Studies*, University Science Press, 2nd Edition, 2018.
2. Botkin and Keller, *Environmental Science: Earth as a Living Planet*, John Wiley & Sons, 8th 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: Courses on Network Analysis, Transformation Techniques and Linear Algebra.

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 – diagnolization 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., 2nd edition, 2014.
2. Katsuhiko Ogata, *Modern Control Engineering*, Pearson Education Publishers, 5th edition, 2010.

REFERENCE BOOKS:

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

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 analyze spectral characteristics of continuous-time periodic and aperiodic signals.

CO3. Analyze the properties of correlation and convolution to extract signals from noisy signal in various applications.

CO4. Apply Laplace transformation technique to analyze the characteristics of LTI systems.

CO5. Analyze sampling & it's 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

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: A course on Basic Electrical and Electronic Engineering and Electronic Devices & 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-π 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 (π) – Common Emitter transistor model, Hybrid-π conductance, Hybrid-π capacitances, validity of Hybrid-π 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, 2nd edition, 2010.
2. Adel S.Sedra, Kenneth C.Smith, *Micro Electronic Circuits Theory and Applications*, OXFORD International Student Edition, 5th edition, ,2009

REFERENCE BOOKS:

1. Robert L. Boylestad and Louis Nashelsky, *Electronic Devices and Circuits Theory*, Pearson Education, 10th Edition, 2009.
2. David A. Bell, *Electronic Devices and Circuits,* Oxford University press, 5th Edition, 2014.
3. S. Salivahanan, N. Suresh Kumar, A Vallvaraj, *Electronic Devices and Circuits*, Mc Graw Hill Education 3rd Edition, 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, 5th Edition, 2018.
2. John F. Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4th Edition, 2008.

REFERENCE BOOKS:

1. Ramakanth A. Gayakwad, *Op-Amps & Linear Integrated Circuits*, Pearson Education, 4th Edition, 2015
2. J. Bhaskar, *A Verilog HDL Primer*, BS Publications, 3rd Edition, 2018

ADDITIONAL LEARNING RESOURCES:

1. https://www.coursera.org/learn/electronics
2. https://www.youtube.com/results?search_query=james+roberge

II B. Tech. – II Semester

(19BT41001) **INDUSTRIAL INSTRUMENTATION**

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

PRE-REQUISITES: Courses on Transducers in Instrumentation, Electrical and Electronic Measurements

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
3. https://www.ibiblio.org/kuphaldt/socratic/sinst/book/liii.pdf

II B. Tech. – II Semester
(19BT4BS01) **MATERIAL SCIENCE**
(Open Elective-1)
(Common to EEE, ECE and EIE)

Int. Marks	Ext. Marks	Total Marks	L	T	P	C
40	60	100	3	0	-	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 nanomaterials 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 nanomaterials), 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, 9th 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, 9th 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, 3rd 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 Resumés – 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, 2nd edition, 2012.
2. Neera Jain and Sharma Mukherji, *Effective Business Communication*, Tata Mc Graw-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
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 of 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. Madhurima Lall & Shikha Sahai, *Entrepreneurship*, Excel Books India, 4th edition, 2014.

REFERENCE BOOKS:

1. Nandan, H., *Fundamentals of Entrepreneurship*, PHI Learning Pvt. Ltd., New Delhi, 3rd edition, 2013.
2. Bholanath Dutta, *Entrepreneurship Management* – Text and Cases, Excel Books, 3rd edition, 2015.

II B. Tech. - II Semester

(19BT4HS06) GERMAN LANGUAGE(Deutsch alsFremdsprache)

(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; Berufsdeutcsch (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 1st and 2nd type, verb Conjugation 3rd 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, 21st 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: 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, 10th edition Indian Reprint, 2011. (6th 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, 2nd Revised Edition, 2011.
2. Stephen P. Robbins and Timothy A. Judge*, Organizational Behaviour*, Prentice Hall, Delhi, 16th edition, 2014.

ADDITIONAL LEARNING RESOURCES:

1. https://www.universalclass.com/.../the-process-of-perso...
2. 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 labourmarket - 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. NayakSarojini, Nair Jeevan, *Women's Empowerment in India*, Pointer Publishers, Jaipur, 2017
2. Sahay Sushama, *Women and Empowerment,* Discovery Publishing House, New Delhi, 2013.

REFERENCE BOOKS:

1. Baluchamy. S, *Women's Empowerment of Women*, Pointer Publishers, Jaipur, 2010
2. Khobragade Grishma, *Women's Empowerment: Challenges and Strategies Empowering Indian Women*, Booksclinic Publishing, Chhattisgarh, 2020.

ADDITIONAL LEARNING RESOURCES

1. https://www.economicsdiscussion.net/entrepreneurship/women-entrepreneurs- in-india
2. 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	2	1	0	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. Briji Kishore Sharma, *Introduction to the Constitution of India*, Prentice Hall of India, 2005.

REFERENCE BOOKS:

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: Differential Equations and Multi-Variable Calculus, and 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*, 2nd edition, Springer, New York, 2013.
2. Frank R. Spellman, Nancy E. Whiting, *Safety Engineering: Principles and Practices*, 3rd edition, Rowman & Littlefield, 2018.

REFERENCE BOOKS:

1. Charles E. Ebeling, *An introduction to reliability and maintainability engineering*,2nd edition Tata McGraw-Hill Education, 2010.
2. Dan Petersen, *Techniques of Safety Management: A Systems Approach*, 4thedition 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=xYWyype7cxE

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., 2nd Edition, 2007.
3. Ibrahim A. Mirsa, *Soil Pollution: Origin, Monitoring & Remediation*, Springer, UK, 2nd Edition, 2008.

REFERENCE BOOKS:

1. M. N. Rao and H. V. N. Rao, *Air Pollution,* Tata McGraw–Hill Education Pvt. Ltd., 19th Edition, 2010.
2. Daniel Vallero, *Fundamentals of Air Pollution,* Academic Press (Elsevier), 5th Edition, 2014.
3. S. M. Khopkar, *Environmental Pollution Monitoring and Control,* New Age International Pvt. Ltd., 2nd 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 STRATAGIES (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., 2nd Edition, 2008.
2. Jennifer A. Elliot, *An Introduction to Sustainable Development*, Earth Scan Publications Ltd., 4th 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., 2nd Edition, 2008.
3. Peter Bartelmus, *Environment Growth and Development: The Concepts and Strategies of Sustainability*, Routledge, 3rd 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, 2nd 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

PRE-REQUISITES:-

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 DEVLOPMENT (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 Saansad Adarsh Gram Yojana (SAGY), Village adoption schemes.

Total Periods: *45*

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. M. S. Virdi, *Sustainable Rural Technologies*, Daya Publishing House, 2nd Edition 2018.
2. S. V. Prabhath and P. Ch. Sita Devi, *Technology and Rural India*, Serials Publications, 1st Edition, 2012.

REFERENCE BOOKS:

1. R. Chakravarthy and P. R. S. Murthy, *Information Technology and Rural Development*, Pacific Book International, 1st Edition, 2012.
2. Shivakanth Singh, *Rural Development Policies and Programmes*, Northern Book Centre, 1st Edition, 2002.
3. Katar Singh and Anil Shishodia*, Rural Development: Principles, Policies, and Management,* SAGE Publications India Private Limited, 4th Edition, 2016.
4. A. Vinayak Reddy, M. Yadagira Charyulu, *Rural Development in India: Policies & Initiatives,* New Century Publications, 1st Edition, 2008.

ADDITIONAL LEARNING RESOURCES:

1. L. M. Prasad, *Principles and Practice of Management*, S. Chand & Sons, 9th Edition, 2019.
2. Venkata Reddy, K., *Agriculture and Rural Development - Gandhian Perspective*, Himalaya Publishing House, 1st 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, Footprinting, 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 footprinting 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 ANDPORT SCANNING (09 Periods)

Footprinting: Using web tools for footprinting, 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*, 3rdEdition, 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*,3rdEdition, 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: 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,* MedManthra Publications, 1st Edition 2019.
2. *Arjun Panesar, Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.

REFERENCE BOOKS:

1. Michael Matheny, Sonoo Thadaney Israni, Mahnoor Ahmed, and Danielle Whicher, *Artificial Intelligence in Health Care: The Hope, the Hype, the Promise, the Peril*, National Academy of Medicine Publication, 1st 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*, Oxford University Press, 4th Edition, 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

(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, 3rd edition, 2012
2. S. Poorna Chandra, B. Sasikala, *Electronics Laboratory Primer*, S. Chand & Company Ltd. 1st 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

II B. Tech. – II Semester

(19BT41031) INDUSTRIAL INSTRUMENTATION LAB

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

PRE-REQUISITES: Electrical and Electronic Measurements, Transducers in 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 Multsim 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, 4th 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 Pallás Areny, 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
5. http://www.ni.com/pdf/manuals/374629c.pdf
6. http://www.ni.com/pdf/manuals/373363f.pdf

II B. Tech. – II Semester

(19BT315AC) DESIGN THINKING

(Audit Course)

(Common to Civil, Mech, ECE, EEE 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 Mc Graw 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
(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
(19BT50442) PRINCIPLES OF COMMUNICATIONS

(Common to EEE and EIE)

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

PRE-REQUISITES: Courses on Signals and Systems / Signals and Networks.

COURSE DESCRIPTION: Fundamentals of Communications; Analog and digital communications - modulation and Demodulation Techniques; Information theory and coding.

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 pulse-analog modulations.

CO3. Understand the concepts of pulse-code modulation and delta modulations.

CO4. Understand various digital carrier modulation schemes.

CO5. Analyze various error detection and correction codes for reliable transmission.

DETAILED SYLLABUS:

UNIT-I: ANALOG MODULATION (13 Periods)

Block diagram of Electrical Communication System, Types of Communications, Need for Modulation, Types of Amplitude Modulation: AM, DSBSC, SSBSC, Power and BW requirements, Generation of AM, DSBSC, SSBSC, Demodulation of AM: Diode detector, Product demodulation for DSBSC & SSBSC, Frequency & Phase Modulations.

UNIT-II: PULSE MODULATION (07 Periods)

Elements & Advantages of Digital communication systems, PAM, Regeneration of Base band Signal, PWM and PPM, Time Division Multiplexing, Frequency Division Multiplexing.

UNIT-III: BASE BAND DIGITAL TRANSMISSION (07 Periods)

Pulse Code Modulation: Advantages, Block diagram of PCM, Quantization, effect of Quantization, Quantization error, DM,ADM and Comparison.

UNIT - IV: PASS BAND DIGITAL TRANSMISSION (10 Periods)

ASK, FSK, PSK, DPSK, QPSK, Modulation and Demodulation-Coherent and Non-coherent techniques

UNIT-V: INFORMATION THEORY AND CODING **(08 Periods)**

Concept of Information, Entropy and Rate of Information, Coding efficiency, Shannon-Fano and Huffman Coding.

Error Correction and Detection Codes: Block Codes, Convolution Codes, Cyclic Codes

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. R.P. Singh and S D Sapre, Communication Systems - Analog and Digital, TMH, 3rd edition 2017.
2. Simon Haykin, Communication Systems, John Wiley, 2nd edition2007.

REFERENCE BOOKS:

1. Herbert Taub, Donald L Schilling & Goutam Sana "Principles of Communication Systems", Tata McGraw-Hill, 4th Edition, 2012.
2. Sham Shanmugam, "Digital and Analog Communication Systems", Wiley-India edition, 2019.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/104/108104091/
2. http://ocw.ump.edu.my/course/view.php?id=266

III B. Tech. – I Semester

(19BT50207) COMPUTER ORGANIZATION AND ARCHITECTURE

(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 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, Programable 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, 5thedition, 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
(19BT50403) VLSI DESIGN

(Professional 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 Switching Theory and 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^2L, 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 ω_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, 3rd Edition, 2003 .

REFERENCE BOOKS:

1. John F.Wakerly, Digital Design Principles & Practices, Pearson Education Asia, 4th Edition, 2008.
2. John M. Rabaey, Digital Integrated Circuits: A Design Perspective, PHI, 2nd Edition, 2003.

III B. Tech. – I Semester
(19BT40501) COMPUTER NETWORKS
(Professional 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: A course on Switching Theory and Logic Design

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, 5th Edition, 2015.

REFERENCE BOOKS:

1. Behrouz A. Forouzan, *Data Communications and Networking*, McGraw Hill, 5th Edition, 2013.
2. James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach*, Pearson, 7th Edition, 2017.

ADDITIONAL LEARNING RESOURCES:

1. https://www.cisco.com/c/en/us/solutions/small-business/resourcecenter/networking/networking-basics.html
2. https://memberfiles.freewebs.com/00/88/103568800/documents/Data.And.Computer.Communications.8e.WilliamStallings.pdf

III B. Tech. – I Semester

(19BT51001) OPTOELECTRONICS AND LASER INSTRUMENTATION

(Professional Elective-1)

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

PRE-REQUISITES: A course on Industrial Instrumentation.

COURSE DESCRIPTION: Optical fibers, components of optical fibers, fiber optic Sensors, Industrial and medical applications of laser.

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

CO1. Apply basic knowledge of optical fibers to select suitable optical fiber sensors for measurement of various physical parameters.

CO2. Identify an appropriate laser system for industrial and medical applications with safety measures.

CO3. Demonstrate knowledge on holographic techniques and its applications.

CO4. Analyze optoelectronic modulators using lasers.

DETAILED SYLLABUS:

UNIT-I: OPTICAL FIBRES AND THEIR PROPERTIES (09 Periods)

Introduction to optical fibers, Basic principle of light propagation through optical fiber, Different types of fibers and their properties, Transmission characteristics of optical fibers: attenuation, fiber loss, dispersion, Optical sources, Optical detectors, Power Coupling, Splicers & Connectors.

UNIT-II: APPLICATIONS OF OPTICAL FIBERS (09 Periods)

Fiber optic instrumentation system, Classification of Fiber-Optic Sensors, Interferometric method of measurement of length, Measurement of pressure, Temperature, Current, Voltage, Liquid level, Strain, Fiber optic gyroscope, Fiber grating sensors, Polarization maintaining fibers.

UNIT-III: FUNDAMENTALS OF LASERS (09 Periods)

Introduction to lasers, Properties of laser, two level, three level and four level laser structures, laser modes, Resonators, Q switching and mode locking, types of lasers: Gas lasers: He-Ne laser, Argon laser, CO_2 laser, Liquid dye laser, solid lasers: Ruby laser, Nd:YAG laser, laser diode.

UNIT-IV: APPLICATIONS OF LASERS (09 Periods)

Industrial applications: Material processing applications- Laser heating, melting, scribing, welding and trimming of materials, removal and vaporization, Light Detection and Ranging, Laser Doppler velocimeter, Laser safety.

Medical applications: laser and tissue interaction – Laser instrument: endoscopy, removal of tumors in vocal cords, lasers in Gynecology: Laser therapy for cervical disease, Ophthalmology: treatment of eye tissues and diseases.

UNIT-V: HOLOGRAPHY AND OPTO-ELECTRONIC MODULATORS (09 Periods)

Holography: Principle of recording and reconstruction of hologram, Holographic Interferometer: Double Exposure Interferometer, Real Time Interferometer, Contour Generation Interferometer, Holographic components/applications of holography.

Opto-electronic modulators: Electro-Optic Modulators, Acousto-Optic Modulators, Magneto-Optic Modulators, Application of electro optic planar waveguide in digital modulation.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. Satyajit Das, "*Optical Instrumentation*", S.K. Kataria & Sons, 2014.
2. Khare, R.P., "*Fiber Optics and Optoelectronics*", Oxford University Press, 2004.
3. Helena Jelinkova, "*Lasers for medical applications: Diagnostics, therapy and surgery*", Woodhead Publishing Limited, 2013.

REFERENCE BOOKS:

1. Das P., "*Lasers and Optical Engineering*", Springers –Verlag New York Inc., Students Edition, 1991.
2. Thyagarajan K. and Ghatak A.K., "*Lasers: Theory and Applications*", Plenum Press, 1981.
3. Arumugam. M, "*Optical Fibre Communication and Sensors*", Anuradha agencies, 2008.

ADDITIONAL LEARNING RESOURCES:

1. https://www.ias.ac.in/article/fulltext/boms/011/02-03/0213-0224
2. https://www.physics-and-radio-electronics.com/physics/laser/laserintroduction.html
3. https://www.daenotes.com/electronics/microwave-radar/co2-gas-laser
4. https://www.photonics.com/Articles/Fiber_Optics_Understanding_the_Basics/a25151
5. https://www.photonics.com/EDU/Handbook.aspx

III B. Tech. – I Semester

(19BT51002) **INTELLIGENT CONTROL**

(Professional Elective-1)

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

PREREQUISITES: A course on Control Systems.

COURSE DESCRIPTION: Fundamentals of neural networks; learning rules; supervised and unsupervised neural network architectures; classical set and fuzzy set fundamentals; fuzzy logic controller, architecture of ANFIS, neuro-fuzzy controller.

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

CO1. Analyze and solve the weights of neurons by applying the fundamental concepts of supervised and unsupervised learning neural networks.

CO2. Apply Fuzzy logic concepts to analyze uncertainty related engineering problems.

CO3. Design a Fuzzy logic control system by applying the Fuzzy logic concepts to control the process.

CO4. Demonstrate the concepts of Neuro-Fuzzy controller.

DETAILED SYLLABUS:

UNIT I: FUNDAMENTALS OF ANN (09 Periods)

Neural networks- introduction, biological neural network; Artificial neural network- advantages, architectures, activation functions; McCulloch-pits neuron model; Learning strategies- supervised, unsupervised and reinforced; Learning rules; Perceptron Model; Concept of linear separability.

UNIT II: ANN STRUCTURES AND NEURAL CONTROL (09 Periods)

Back Propagation Neural Network (BPNN) - architecture, training algorithm, learning factors, initial weights, steepness of the activation function, learning constant, momentum method and necessary number of hidden neurons. Radial Basis Function Network (RBFN) - Architecture and training algorithm, Kohonen Self-Organization Network - Architecture and training algorithm, Hopfield Network - Architecture and training algorithm. Neural Control Strategies: Direct and indirect adaptive methods, reinforcement learning.

UNIT III: CLASSICAL SETS AND FUZZY SETS (09 Periods)

Classical sets - operations, properties. Crisp relations - cardinality, operations, properties, Cartesian product, composition.

Fuzzy sets - operations, properties. Fuzzy relations - cardinality, operations, properties, fuzzy Cartesian product, composition. Linguistic hedges, membership functions - features, methods of membership value assignments - intuition, inference, rank ordering, inductive reasoning.

UNIT IV: FUZZY LOGIC CONTROL (09 Periods)

Defuzzification methods - max membership principle, weighted average, centroid, center of sums. Fuzzy rule base - formation of rules, decomposition of rules, aggregation of rules, Mamdani Fuzzy model, TSK Fuzzy model, Fuzzy logic controller- design procedure.

Speed control of DC motor - need of fuzzy logic, selection of membership functions, design of rule base for speed control.

UNIT V: NEURO-FUZZY MODELING AND CONTROL (09 Periods)

Neuro-fuzzy control: Overview, ANFIS architecture, Hybrid learning algorithm, expert control, Inverse learning, specialized learning, Back propagation through time and real time recurrent learning, Neuro-fuzzy controller.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. S.N. Sivanandam, S.N. Deepa, *Principles of Soft computing*, 2nd edition Wiley India private Ltd., 2013.
2. Timothy J Ross, *Fuzzy Logic with Engineering Application*, 3rd edition, McGraw Hill Inc., 2014.

REFERENCE BOOKS:

1. J Roger Jang, Chuen-Tsai Sun and Eiji Mizutani, *Neuro-Fuzzy and Soft Computing: A Computational Approach to Learning and Machine Intelligence*, Prentice Hall, Englewood cliffs, N.J., 1997
2. Johan A.K. Suykens, Joos P.L. Vandewalle, B.L. de Moor, *Artificial Neural Networks for Modelling and Control of Non-Linear Systems,* Kluwer Academic Publishers,1996
3. Pedro Ponce-Cruz, Fernando D. Ramirez-Figueroa, *Intelligent Control Systems with LabVIEW,* Springer London, 2010
4. S. Rajasekaran, G.A. Vijayalakshmi Pai, *Neural Networks, Fuzzy Systems and Evolutionary Algorithms : Synthesis and Applications*, PHI, 2nd edition, 2017

ADDITIONAL LEARNING RESOURCES:

1. https://academic.csuohio.edu/simond/courses/eec645/
2. https://nptel.ac.in/courses/108/104/108104049/

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. Ranganadha Chary,A.V. and Paul, R.R., *Banking and Financial system*, Kalyani Publisher, New Delhi, 3rd edition, 2016.
2. Sharma,R.K., Shashi K. Gupta and Jagwant Singh, *Banking and Insurance*, Kalyani Publishers, New Delhi, 17th 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., 2nd 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).

UNI-T 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, 10th edition, 2016.
2. I.M. Pandey, *Financial Management*, Vikas Publishing House Pvt. Ltd., 14th 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 ANDENVIRONMENT 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 ANDSUSTAINABLE 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, 62nd revised edition, 2010.
2. Misra. S. K. and V. K. Puri., *Indian Economy*: Its Development Experience, Himalaya Publishing House, Mumbai, 32nd 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 ECE, EEE 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, 3rd 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 Aachaarya 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, 2nd 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, 3rd 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, 1st Edition, 2012.

REFERENCE BOOKS:

1. Bradley. A.S; Adebayo, A.O., Maria, P., *Engineering Applications in Sustainable Design and Developmen*t, Cengage Learning, 1st Edition, 2016.
2. Purohit, S. S., *Green Technology: An Approach for Sustainable Environment*, Agrobios Publication, 1st 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, 3rd Edition, 2015.

ADDITIONAL LEARNING RESOURCES:

1. Daniel A. Vallero and Chris Brasier, *Sustainable Design: The Science of Sustainability and Green Engineering*, Wiley-Blackwell, 1st 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, 1st 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., 11th Edition, 2011.
2. Jimmie Hinze, *Construction Contracts,* McGraw Hill, 3nd Edition, 2011.

REFERENCES BOOKS:

1. Kishore Gajaria, *GT Gajaria's Law Relating to Building and Engineering Contracts in India*, Lexis Nexis Butterworths India,4th Edition, 2000.
2. Patil, B. S., *Civil Engineering Contracts and Estimates*, University Press (India) Private Ltd., 4thEdition, 2015.
3. Joseph T. Bockrath, *Contracts and the Legal Environment for Engineers and Architects*, McGraw Hill Education,7th 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, 5thEdition, 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.

UNI-T 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, 3rdEdition, 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, 1stEdition, 2007.
2. S.K.Mandak, *Ethics in Business and Corporate Governance*, TMH, 2ndEdition, 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, 2nd Edition, 2006.
2. Koontz and Weihrich, *Essentials of Management*, TMH, 6th 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, 2nd 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 Act2000, 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:

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:

1. https://swayam.gov.in/nd2_cec20_cs09/preview
2. 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, 4th 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. 1st 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

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, MichelaMeo, 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*, SynchronaThemata, 2012.

III B. Tech. – I Semester

(19BT50341) INDUSTRIAL SAFETY AND MAINTENANCE ENGINEERING

(Inter Disciplinary Elective-1)

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

PRE-REQUISITES: --

COURSEDESCRIPTION: Maintenance; Maintenance Management and Control; Types Of Maintenance; Inventory Control In Maintenance; Quality And Safety In Maintenance; Maintenance Costing; Reliability; Reliability Centered Maintenance; Maintainability;

COURSEOUTCOMES: After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge of engineering maintenance strategy, management and control.

CO2. Analyze maintenance strategies and inventory control models for reducing downtime and cost.

CO3. Analyze the strategies of quality control, safe maintenance practices and maintenance costing to improve productivity.

CO4. Apply reliability centred maintenance strategy to improve the performance.

CO5. Analyze necessary functions, and measures for maintainability to achieve effectiveness, safety, and economy of maintenance.

DETAILED SYLLABUS:

UNIT-I: MAINTENANCE MANAGEMENT AND CONTROL (09 Periods)

Introduction: Need for Maintenance, Facts and Figures, Modern Maintenance, Problem and Maintenance Strategy for the 21st Century, Engineering Maintenance Objectives and Maintenance in Equipment Life Cycle, Terms and Definitions.

Maintenance Management and Control: Maintenance Manual, Maintenance, Facility Evaluation, Functions of Effective Maintenance Management, Maintenance Project Control Methods, Maintenance Management Control Indices.

UNIT-II: Maintenance and Inventory Control in Maintenance (10 Periods)

Types Of Maintenance: Preventive Maintenance, Elements of Preventive, Maintenance Program, Establishing Preventive Maintenance Program PM Program Evaluation and Improvement, PM Measures, PM Models, Corrective Maintenance, Corrective Maintenance Types, Corrective Maintenance Steps and Downtime Components, Corrective Maintenance Measures, Corrective Maintenance Models, Predictive Maintenance, Total productive Maintenance.

Inventory Control in Maintenance: Inventory Control Objectives and Basic Inventory Decisions, ABC Inventory Control Method, Inventory Control Models Two-Bin Inventory Control and Safety Stock, Spares Determination Factors Spares Calculation Methods

UNIT-III: QUALITY AND SAFETY IN MAINTENANCE (09 Periods)

Quality and Safety in Maintenance: Needs for Quality Maintenance Processes, Maintenance Work Quality, Use of Quality Control Charts in Maintenance Work Sampling, Post Maintenance Testing, Reasons for Safety Problems in Maintenance, Guidelines to Improve Safety in Maintenance Work, Safety Officer's Role in Maintenance Work, Protection of Maintenance Workers.

Maintenance Costing: Reasons for Maintenance Costing, Maintenance Budget Preparation Methods and Steps, Maintenance Labor Cost Estimation, Material Cost Estimation, Equipment Life Cycle Maintenance Cost Estimation, Maintenance Cost Estimation Models.

UNIT-IV: RELIABILITY CENTRED MAINTENANCE (09 Periods)

Reliability, Reliability Centred Maintenance: Goals And Principles, RCM Process and Associated Questions, RCM Program Components Effectiveness Measurement Indicators, RCM Benefits and Reasons for Its Failures, Reliability Versus Maintenance and Reliability in Support Phase, Bathtub Hazard Rate Concept, Reliability Measures and Formulas, Reliability Networks, Reliability Analysis Techniques.

UNIT-V: MAINTAINABILITY (08 Periods)

Maintainability: Maintainability Importance and Objective, Maintainability in Systems Life Cycle, Maintainability Design Characteristics, Maintainability Functions and Measures, Common Maintainability Design Errors.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. A.K. Gupta, "Reliability, Maintenance and Safety Engineering", Laxmi Publications,1st edition, January 2015.
2. L.M. Deshmukh, "Industrial Safety Management", McGraw Hill Education, 1stedition July 2017.

REFERENCES:

1. R. C. Mishra, "Maintenance Engineering & Management", Prentice Hall India Learning Private Limited,2nd edition, January 2012.
2. Elsayed. A, "Reliability Engineering", John Wiley and Sons, 2ndedition, 2012.
3. B.S Dhallon, "Engineering Maintenance a modern approach", C.R.R Publishers,2nd edition,2002.
4. Alakesh Manna, "A Text Book of Reliability and Maintenance Engineering" , IK International Publishing House, 3rd edition, 2012.
5. NVS Raju, "Plant Maintenance and Reliability Engineering", Cengage Learning India, 1st edition, 2011.

III B. Tech. – I Semester

(19BT50343) **THERMODYNAMICS AND FLUID MECHANICS**

(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: Thermodynamic system; Energy interactions; Work transfer and Heat Transfer in flow and non- flow systems; Laws of thermodynamics; Entropy; Air cycles; Refrigeration; Properties of Fluids; Pressure Measurements; Types of flow; One-dimensional steady flow energy & momentum Equations; Flow measurements; Hydraulic turbines and its performance; Pumps.

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

CO1. Demonstrate knowledge of thermodynamic system, properties, Processes, and Cycles.

CO2. Analyze thermodynamic systems using first law of thermodynamics.

CO3. Analyze thermodynamic systems using second law of thermodynamics.

CO4. Analyze fluid systems using principles of fluid mechanics and determine fluid properties.

CO5. Analyze functional characteristics of turbines and pumps.

DETAILED SYLLABUS:

UNIT - I: BASIC CONCEPTS OF THERMODYNAMICS (09 Periods)

Microscopic and macroscopic point of view, Thermodynamicsystems, Control volume, Thermodynamic properties, Processes, Cycle, Homogeneous and Heterogeneous systems,

Thermodynamic equilibrium, Quasi – static process, Concept ofcontinuum, Work transfer and Heat transfer, Point and pathfunction, Zeroth law of thermodynamics.

UNIT - II: FIRST LAW OF THERMODYNAMICS (09 Periods)

First Law of Thermodynamics: First law for a closed systemundergoing a cycle, First law for a closed system undergoing achange of state, Limitations of first Law, Perpetual motionmachine of first kind (PMM1), Energy a property of system,First law applied to a flow process - steady flow energy equation(SFEE).

UNIT - III: SECOND LAW OF THERMODYNAMICS (09 Periods)

Second Law of Thermodynamics: Energy reservoir, Kelvin plank and Clausius statements of second law and theirequivalence, PMM of second kind (PMM2), Heat engine, Refrigerator, Heat pump, Reversibility and Irreversibility, Carnot cycle.

UNIT-IV: FLUID PROPERTIES, FLUIDSKINEMATICS AND DYNAMICS 09 Periods)
Basic Concepts of Fluid Mechanics, Types of fluids, Properties, Laws of pressure, Atmospheric Pressure, Gauge Pressure, Pressure Measurement- Piezometer, Manometers and Mechanical Gauges; Analysis of Flow of Fluids, Stream line, path line and streak lines, classification of various fluid flows, Equation of Continuity for one dimensional flow, Euler's and Bernoulli's equations for flow along a stream line.

UNIT-V: HYDRAULIC MACHINES (09 Periods)
Turbines: Basic concepts, Classification, Working Principles of Pelton wheel turbine and Francis turbine.

Pumps: Basic concepts, Classifications, Working principles of Centrifugal and Reciprocating pumps.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. P. K. Nag, *Engineering Thermodynamics*, TMH, 5th Edition, 2013.
2. R.K.Rajput, *Fluid Mechanics and Hydraulic Machines*, S.Chand and company Ltd., 2nd Edition, 2002.

REFERENCE BOOKS:

1. R.K.Rajput, *Thermal Engineering*, Laxmi Publications (P) Ltd, 10th Edition, 2017.
2. R.K.Bansal, *Fluid Mechanics and Hydraulic Machines*, Laxmi Publications (P) Ltd, 10th Edition, 2017.

III B. Tech. – I Semester

(19BT50502) **ARTIFICIAL INTELLIGENCE**

(Inter Disciplinary Elective-1)
(Common to CSE, CSSE and EIE)

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

PRE-REQUISITES: A Course on Discrete Mathematical Structures.

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 ethicalimplications 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 – Agentsand 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 – Theminimax 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 – Timeand 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 lesson plan

TEXT BOOK:

1. Stuart Russell, Peter Norvig, *Artificial Intelligence: A Modern Approach*, Prentice Hall, 4th Edition, 2020.

REFERENCE BOOKS:

1. Stephen Lucci, Danny Kopec, *Artificial Intelligence in the 21st Century*, Mercury Learning and Information, 3rd Edition,2018.
2. Rich, Knight, Nair,*Artificial intelligence*, Tata McGraw Hill, 3rdEdition, 2009.
3. Deepak Khemani, *A First Course in Artificial Intelligence*, McGraw Hill, 2017.
4. Saroj Kaushik,*Artificial Intelligence,* Cengage Learning, 2011.

ADDITIONAL RESOURCES:

1. https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence
2. http://aima.cs.berkeley.edu/
3. https://ai.google/education/
4. https://www.coursera.org/courses?query=artificial%20intelligence
5. https://www.edureka.co/blog/artificial-intelligence-with-python/

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 Tokenizer, 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 RAMEWORK (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: FrameworkHierarchy, ArrayList, LinkedList, HashSet.

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*, 9th edition, Oracle Press, 2014.

REFERENCE BOOKS:

1. SachinMalhotra and SaurabChoudhary, *Programming in Java*, 2nd 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

1. https://docs.oracle.com/javase/tutorial/index.html

III B. Tech. – I Semester

(19BT61531) INTERNET OF THINGS LAB

(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: 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 HakinCassimally, *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
(19BT51031) **SIGNAL PROCESSING LAB**

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

PRE-REQUISITES: Courses on Signals and Systems, Principles of Communications, Digital Signal Processing.

COURSE DESCRIPTION: Basics of programming using any simulation software, Operations on Signals & sequences, Convolution and correlation, Verification of sampling theorem, Pole-zero mapping, Power Spectral Density, Filter designing; SSB-SC and ASK, Study architecture of DSP processor kits and performing basic operations on it, Real-time signal processing like digital filter design (FIR, IIR) and FFT implementation using DSP processor kits.

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

- CO1. Analyze different operations on signals and sequences using simulation and hardware tools.
- CO2. Verify sampling theorem using simulation tools.
- CO3. Design different types of FIR and IIR filters using simulation and hardware tools for an application.
- CO4. Develop and verify the program using a DSP processor for an application.
- CO5. Work independently or in teams to solve problems with effective communication.

List of Experiments:

Part – I (Minimum of SIX experiments to be conducted)

1. Generation of Various signals and Sequences (Periodic and Aperiodic), Such as Unit Impulse, Unit Step, Square, Saw Tooth, Sinusoidal, Ramp, Sinc function.
2. Operations on Signals and Sequences such as Addition, Multiplication, Scaling, Shifting, Folding.
3. Convolution and correlation of signals and sequences.
4. Verification of sampling theorem.
5. Locating the zeros and poles and plotting the pole zero maps in s-plane and z-plane for the given transfer function.
6. Generation of Gaussian Noise (real and complex), computation of its mean, M.S. Value and its skew, kurtosis, and PSD, probability distribution function.
7. Implement N-point DFT & IDFT

8. Design of FIR filter using windowing method.
9. Design of Butterworth filter.
10. Design of Digital Filter from Analog filters (Bilinear Transformation and Impulse Invariant Transformation).
11. SSB-SC and FSK implementation.

Part – II (Minimum of FOUR experiments to be conducted))

1. Study of TMS320C5X/6X DSP Processor architecture, Study of DSK6713 Hardware and Software API
2. To blink on board LEDs in TMS320C5X/6X, to observe the operation of Line-In Line-Out.
3. Sine Wave Generation using Look up Table Method.
4. FFT Implementation of given discrete sequence.
5. FIR Filter Implementation for given specifications.
6. IIR Filter Implementation for given specifications.

REFERENCE BOOKS/LABORATORY MANUALS:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing, Principles, Algorithms and Applications*, 4th edition, Pearson Education/PHI, 2007.
2. B.Venkataramani, M. Bhaskar, *Digital Signal Processors – Architecture, programming and Applications,* 2nd edition, TATA McGraw Hill, 2010.

SOFTWARE/Tools used:

MATLAB 2019a.

Code Composer Studio.

ADDITIONAL LEARNING RESOURCES:

1. https://in.mathworks.com/
2. https://matlabacademy.mathworks.com/
3. https://www.ti.com/product/TMS320C5505
4. https://www.pantechsolutions.net/tms320c5505-dsp-starter-board

III B. Tech. – I Semester
(19BT51032) **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.

OURSE 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, EEE, ECE and EIE)

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

PRE-REQUISITES: -

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 EEE, ECE and EIE)

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

PRE REQUISITE: --

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

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, 2nd edition, 2016.
2. S.P. Jain and K.L. Narang, *Financial Accounting*, Kalyani Publishers, Ludhiana, 12th edition, 2018.

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.(3,4)

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,* 3rd 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
(19BT61001) PROCESS CONTROL INSTRUMENTATION

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

PRE-REQUISITES: Courses on Control Systems, Electrical and Electronic Measurements, Industrial Instrumentation.

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 reflex rate, constant reflex 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, 7th Edition, 2002.
3. G. Stephanopoulis, *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, 2nd 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

(19BT60203) ADVANCED CONTROL SYSTEMS

(Professional Elective-2)

(Common to EEE and EIE)

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

PRE-REQUISITES: A course on Control systems.

COURSE DESCRIPTION: State space analysis; design of compensators and controllers; describing function for non-linear systems, phase-plane analysis; Lyapunov's stability analysis.

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

CO1. Design state feedback controller and observer by applying knowledge on controllability and observability.

CO2. Design the compensators and controllers to enhance the performance of the system using root locus technique.

CO3. Analyze the non-linear control system stability using describing function and phase-plane analysis.

CO4. Investigate the stability of non-linear system by applying Lyapunov stability.

DETAILED SYLLABUS:

UNIT-I: STATE SPACE ANALYSIS AND STATE FEEDBACK CONTROL (12 Periods)

Review of state space analysis, Canonical forms —controllable canonical form, observable canonical form and Jordan canonical form; Test for controllability and observability for continuous time invariant systems and principle of duality; Design of state feedback control through pole placement technique — direct substitution method and Ackermann’s formula. full-order observer and reduced-order observer.

UNIT-II: COMPENSATORS AND CONTROLLERS (10 Periods)

Introduction to preliminary design considerations, Lag, lead and lag-lead compensator; Compensator design based on root locus. Types of controllers, tuning rules for PID controller, design of PI, PD and PID controllers using frequency domain and root locus techniques.

UNIT-III: NON-LINEAR SYSTEMS (09 Periods)

Introduction to non-linear systems, common non-linearities in control systems; study of nonlinear systems — describing function method, derivation of describing function for saturation, ideal relay, relay with dead-zone, backlash, stability analysis with describing function.

UNIT-IV: PHASE PLANE ANALYSIS (07 Periods)

Concept of phase plane analysis — singular-points, concept of limit cycle construction of phase trajectory by analytical method, isocline and delta methods.

UNIT-V: LYAPUNOV STABILITY (07 Periods)

Introduction — Stability in the sense of Lyapunov; Lyapunov's stability and Lypanov's instability theorems; Lyapunov function for linear system, Lyapunov function for non-linear systems — Krasooviski's, variable gradient method.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. Katsuhiko Ogata, *Modern Control Engineering*, 5th edition,Pearson, 2010.
2. M. Gopal, *Control Systems Principles and Design*, 4th edition, McGraw Hill Education (India) Private Limited, NewDelhi, Eleventh reprint 2016.

REFERENCE BOOKS:

1. A. Nagoorkani, *Advanced Control Theory,* 3nd edition, CBS Publishers and Distributors Pvt Ltd, March 2020.
2. I.J Nagarth, M.Gopal, *Control systems Engineering,*6th edition, New Age International Publishers, September 2018.

ADDITIONAL LEARNING RESOURCES:

1. http://www.nptelvideos.in/2012/11/advanced-control-system-design_27.html
2. https://swayam.gov.in/nd1_noc19_de04/preview

III B. Tech. – II Semester

(19BT50406) FPGA ARCHITECTURES AND APPLICATIONS

(Professional Elective-2)
(Common to EEE 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.

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 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 FPGA's (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, 3rd edition,* Cengage Learning,2017.

REFERENCE BOOKS:

1. John V. Oldfield, Richard C. Dorf , Field Programmable Gate Arrays, Wiley India,2008.
2. Pak K. Chan/SamihaMourad , Wayne Wolf, Digital Design Using Field Programmable Gate Arrays, Pearson Low Price Edition,2009.

ADDITIONAL LEARNING RESOURCES

1. http://www2.eng.cam.ac.uk/~dmh/4b7/resource/section16.htm
2. https://nptel.ac.in/courses/106103016/21
3. https://nptel.ac.in/courses/106105161/54

III B. Tech. – II Semester

(19BT61002) **ANALYTICAL INSTRUMENTATION**

(Professional Elective-2)

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

PRE-REQUISITES: Courses on Engineering Chemistry, Electrical and Electronic Measurements.

COURSE DESCRIPTION: Different types of Liquid and Gas analyzers, environmental pollution monitoring instruments and radiation detectors, chromatography, Spectroscopic techniques.

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

CO1. Analyze the gases and liquids present in a sample by applying an appropriate instrumental method.

CO2. Apply different analytical instruments for quantitative and qualitative analysis of chemical samples.

CO3. Use radiation detectors to measure radioactive isotopes in real time applications with safety constraints.

CO4. Identify an appropriate instrument to measure the toxic pollutants for environmental sustainability.

DETAILED SYLLABUS:

UNIT-I: GAS ANALYZERS AND LIQUID ANALYZERS (09 Periods)

Introduction to analyzers, Elements of analytical instruments, Methods of Analysis – Qualitative and quantitative.

Gas Analysis: Thermal Conductivity Type, Paramagnetic Oxygen Analyzer, Magnetic wind Instrument, Hydrogen analyzer, Sodium analyzer, Silica analyzer.

Liquid analysis: Different Electrodes: Ion selective electrodes (ammonia and Fluoride), principle of pH measurement, Electrodes for pH measurement, pH meters, Dissolved Oxygen analyzer, Polarographs, conductivity meters and its types.

UNIT-II: CHROMATOGRAPHY (09 Periods)

Gas Chromatography: Introduction, Principle, Types of detection systems: Flame ionization detector, Argon ionization detector, Electron capture detector, Photo ionization detector and applications.

Liquid chromatography: Introduction, Principle, Types of detection systems: Fluorescence detector, Refractive index detector, thermal detector, mass detector and applications.

UNIT-III: SPECTROPHOTOMETERIC TECHNIQUES (09 Periods)

Electromagnetic Spectrum, Classification of spectroscopic techniques, Beer - Lamberts law, various components of absorption instrument, colorimeter: single beam and double beam, UV-VIS spectrophotometers: single beam and double beam, IR spectrophotometers: basic components, types: optical null method and ratio recording method, FTIR spectrophotometer.

UNIT-IV: SPECTROMETRIC TECHNIQUES (09 Periods)

Atomic absorption spectrometer, Atomic Emission spectrometer, flame photometer: principle and construction, Mass spectrometer: Magnetic deflection, Time of Flight, Radio frequency, Quadrupole, NMR spectrometer-principle, Continuous-wave NMR spectrometer, Pulsed Fourier Transform NMR spectrometer, ESR spectrometer, X-ray spectroscopy.

UNIT-V: ENVIRONMENTAL POLLUTION MONITORING INSTRUMENTS AND RADIATION DETECTORS (09 Periods)

Environmental Pollution Monitoring Instruments: Carbon Monoxide, Sulphur Dioxide, Nitrogen Oxides, Hydrocarbons, Hydrogen sulfide (H_2S), Turbidity and nephelometery, Ozone and safety measures.

Nuclear Radiation Detectors: Types and properties of radioactive emission, radioactive detectors- Gas filled: Ionization chamber, Geiger-Muller counter, proportional counter; scintillation counter, Gamma counters: semiconductor detector.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. R.S. Khandpur, "*Handbook of Analytical Instruments*", TMH, 3rd Edition, 2015.
2. Francis Rousseau and Annick Rouesssac, "*Chemical analysis Modern Instrumentation Methods & Techniques*", John Wiley & sons Ltd., 2007.

REFERENCE BOOKS:

1. Jack Cazes, "*Ewing's Analytical Instrumentation Handbook*", Marcel Dekker, 3rd Edition, 2005.
2. Jain R.K., "*Mechanical and Industrial Measurements*", Khanna Publishing, New Delhi, 10th edition, 1992.
3. Liptak B.G, "*Process Measurement and Analysis*", Volume-1, CRC press, 4th edition, 2003.

ADDITIONAL LEARNING RESOURCES:

1. http://www.pci.tu-bs.de/aggericke/PC4/Kap_I/beerslaw.htm
2. https://www.sigmaaldrich.com/analytical-chromatography.html
3. https://nptel.ac.in/content/storage2/nptel_data3/html/mhrd/ict/text/103105130/lec55.pdf
4. https://www.mt.com/in/en/home/products/Process-Analytics/sodium-silica-analyzer/sensor-sodium-Na.html#documents

III B. Tech. – II Semester
(19BT61003) INDUSTRIAL DATA COMMUNICATIONS

(Professional Elective-2)
(Common to EEE and EIE)

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

PRE-REQUISITES: A course on Computer Networks

COURSE DESCRIPTION: Data networks, inter-networking and serial communications, HART and Field buses, MODBUS, PROFIBUS, Communication protocol, industrial Ethernet and wireless communication.

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

CO1. Demonstrate knowledge on fundamentals of industrial data communication.

CO2. Analyze interfacing standards EIA-232 and EIA-485.

CO3. Select a communication protocol for particular application.

CO4. Demonstrate knowledge on foundation field bus.

DETAILED SYLLABUS:

UNIT-I: INDUSTRIAL DATA COMMUNICATION METHODOLOGY (09 Periods)
Modern instrumentation and control systems, Open systems interconnection (OSI) model, Protocols, Standards Common problems and solutions, General comments on troubleshooting, a specific methodology, Grounding/shielding and noise, Sources of electrical noise, Electrical coupling of noise, Shielding, Cable ducting or raceways, Cable spacing, earthing and grounding requirements, Suppression techniques, Filtering.

UNIT-II: EIA-232 & EIA-485 INTERFACE STANDARD (09 Periods)
EIA-232 interface standard: the major elements of EIA-232, Half-duplex operation of the EIA-232 interface, EIA/TIA-232 revisions, Limitations of EIA-232, troubleshooting: Introduction, Typical approach, Test equipment, Typical EIA-232 problems.EIA-485 interface standard, Troubleshooting. Introduction, EIA-485 vs EIA-422, EIA-485 installation, Noise problems, Test equipment.

UNIT-III: HART PROTOCOL & AS-INTERFACE (AS-I) (07 Periods)
Introduction to HART and smart instrumentation, HART protocol: Physical layer, Data link layer, Application layer, troubleshooting. Introduction to AS-interface, Layer 1 – the physical layer, Layer 2 – the data link layer, Operating characteristics, Troubleshooting: Introduction, Tools of the trade.

UNIT-IV: PROFIBUS PA/DP/FMS PROTOCOL (11 Periods)
Introduction, ProfiBus protocol stack: Physical layer (layer 1), Data link layer (layer 2), Application layer, Fieldbus message specification (FMS), Lower layer interface (LLI), Fieldbus management layer (FMA 7), The ProfiBus communication model, Relationship

between application process and communication, Communication objects, Performance, System operation: Configuration, Data transfer between DPM1 and the DP-slaves, Synchronization and freeze modes, Safety and protection of stations, Mixed operation of FMS and DP stations, Troubleshooting: Introduction, Troubleshooting tools.

UNIT-V: FOUNDATION FIELDBUS (09 Periods)

Introduction to Foundation Fieldbus, The physical layer and wiring rules, The data link layer, The application layer, The user layer, Error detection and diagnostics, High-speed Ethernet (HSE), Good wiring and installation practice with Fieldbus: Termination preparation, Installation of the complete system, Troubleshooting: Introduction, Power problems, Communication problems, Foundation Fieldbus test equipment.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOK:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier First Edition, 2004.

REFERENCE BOOKS:

1. Sunit Kumar Sen, Fieldbus and Networking in Process Automation, CRC Press.,1st edition, 2014.
2. Andrew S. Tanenbaum, David J. Wetherall, Computer Networks, Prentice Hall of India Pvt. Ltd., 5th Edition. 2011.
3. Theodore S Rappaport, Wireless Communication: Principles and Practice, Prentice Hall of India 2nd Edition, 2001.
4. William Stallings, Wireless Communication & Networks, Prentice Hall of India, 2nd Edition, 2005.

ADDITIONAL LEARNING RESOURCES:

1. http://gtu-info.com/Subject/171703/IDC/Industrial_Data_Communication/Syllabus
2. https://www.gtu.ac.in/syllabus/NEW_Diploma/Sem6/3361704.pdf
3. https://rmd.ac.in/dept/eie/notes/7/IDN/syllabus.pdf
4. https://www.inspirenignite.com/anna-university/anna-university-b-tech-ic-r13-7th-sem-industrial-data-networks-syllabus/

III B. Tech. – II Semester
(19BT50342) **ROBOTICS AND AUTOMATION**
(Professional Elective-3)

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

PRE-REQUISITES: -

COURSEDESCRIPTION: Introduction to automation; Need and levels of automation; Applications of automation; Programmable logical controller; Introduction to robotics; End effectors; Robotic drive mechanisms; Manipulator kinematics; Manipulator dynamics; Trajectory planning; Sensors; Robotic programming; Robotic application; Artificial intelligence; Case studies;

COURSEOUTCOMES: After successful completion of this course, the students will be able to:

CO1. Demonstrate the knowledge of automation and usage of programmable logical controllers.

CO2. Demonstrate the knowledge of robotics, end effector and drive systems associated with a robot.

CO3. Analyze different robotic manipulations for robotic kinematics and dynamic motion planning.

CO4. Analyze trajectory planning for robotics path planning and sensors for vision.

CO5. Demonstrate the robotic programming applications and implementing artificial intelligence strategies.

DETAILED SYLLABUS:

UNIT - I: AUTOMATION (09 Periods)

Introduction to automation; Need; Elements; Types of automation systems; Levels of automation: Applications of automation; Goals; Programmable Logical Controller, Hardware, Architecture of PLC system, Power supplies and Isolators, Selection of PLC Systems-Allen Bradley, Omron, Mitsubishi. IEC Standard, Programming PLC’s, Networking of PLC’s, Advantages and Disadvantages of PLC.

UNIT - II: ROBOTICS (09 Periods)

Introduction to Robot, History, Classifications, law of robotics, Anatomy, Configuration of robots, Joint notation schemes, Work volume, Degrees of freedom, End effectors-Classification of End effectors, Tools as end effectors; Drivesystem for grippers - Mechanical, Adhesive, Vacuum, Magnetic; Hooks & scoops, Gripper force analysis and gripper design, Activeand Passive grippers; Robot Drive Mechanisms - Hydraulic, Electric-Servomotor, Stepper Motor, Pneumatic drives.

UNIT-III: MANIPULATOR KINEMATICS AND DYNAMICS (09 Periods)

Manipulator kinematics: Mathematical Preliminaries on Vectors& Matrices, Homogeneous transformations as applicable torotation and translation, (D-H) notation, forward kinematics, Inverse kinematics, Manipulators with two, Three degrees of freedom. Manipulator dynamics: Introduction, Inertia of a Link, Lagrangian formulation for a planar 2R manipulator

UNIT-IV: TRAJECTORY PLANNING AND SENSORS (09 Periods)

Trajectory planning: Trajectory planning and avoidance of obstacles, Path planning, Skew motion, Joint integrated motion, straight line motion.

Sensors: Position sensors, Velocity sensors, Tactile sensors, Proximity sensors, Machine vision sensors, Fail safe hazard sensor systems and Compliance mechanism.

UNIT - V: ROBOT PROGRAMMING AND APPLICATIONS (09 Periods)

Robot programming: Types, Features of languages and Software packages. Robot application: Robot Application in Industry, Task programming, Goals of AI Research, AI Techniques, Robot Intelligence and Task Planning, Modern Robots, Future Application and Challenges, and Case Studies.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. M.P. Groover, *Industrial Robotics: Technology, Programming, and Applications*, Tata McGraw-Hill, 2008.
2. John. J. Craig, *Introduction to Robotics: Mechanics and Control*, Pearson/Prentice Hall, 3rd Edition, 2005.

REFERENCE BOOKS:

1. S.K. Singh, *Computer Aided Process Control*, PHI, 2009.
2. Bolton. W, *Programmable Logic Controllers*, 5th edition, 2009.
3. K. S. Fu., R. C. Gonzalez, C. S. G. Lee, *Robotics: Control Sensing, Vision and Intelligence,* International Edition, Tata McGraw Hill, 2008.
4. John W. *Webb* and Ronald A. Reis, Programmable Logic Controllers-Principles and Applications, Pearson Education, 5th Edition, 2002

III B. Tech. – II Semester

(19BT60405) **DIGITAL IC DESIGN**

(Professional Elective-3)

(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 , 2nd Edition, 2016.
2. Kamran Eshranghian, Douglas A.Pucknell and Sholeh Eshranghian‖, *Essential of VLSI Circuits and Systems"*, PHI, 1st edition, 2005.

REFERENCE BOOKS:

1. Sung-Mo Kang & Yusuf Leblebici, *CMOS Digital Integrated Circuits-*‖, 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

(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: Courses on Signals and Systems & 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, 4th 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
(19BT61004) POWER PLANT INSTRUMENTATION
(Professional Elective-3)

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

PRE-REQUISITES: A Course on Industrial Instrumentation.

COURSE DESCRIPTION: Different methods of power generation, Instrumentation and control in water and air-fuel circuit, Turbine monitoring and control, Power plant maintenance.

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

CO1. Demonstrate knowledge on different power generation methods.

CO2. Analyze the various parameters like temperature, pressure, level measured in power plant.

CO3. Apply different control schemes in water and air fuel circuits in a power plant

CO4. Select suitable instruments to measure various parameters of turbine.

CO5. Demonstrate knowledge on power plant safety and maintenance of instruments.

DETAILED SYLLABUS:

UNIT-I: AN OVERVIEW OF POWER GENERATION (09 Periods)

Methods of power generation: Hydro, Nuclear, Solar, Wind, Thermal, Tidal, Geothermal, classification of instruments in a power plant, Objectives of instrumentation and control, Cogeneration.

UNIT-II: INSTRUMENTATION IN WATER CIRCUIT AND AIR-FUEL CIRCUIT (10 Periods)

Measurements in water circuit: Water circuit, Water flow measurement, Differential pressure transmitter, Steam flow measurement, Water and Steam pressure measurements, Water and steam temperature measurements, Drum water level measurement in power plant.

Measurements in Air-fuel circuit: Air-fuel circuit- fuels, Combustion air, Flue gases, Waste gases, Measurement of Flow/Quantity, Pressure, Temperature, level in power plant.

UNIT –III: CONTROLS IN WATER CIRCUIT AND AIR-FUEL CIRCUIT (10 Periods)

Controls in water circuit: Boiler drum level- single element drum level control, Superheated steam temperature control- waterside steam temperature control, Cascade steam temperature control, Feed forward-plus-feedback steam temperature control, Fire side steam temperature control, Steam pressure control.

Controls in Air-fuel circuit: Combustion control, Furnace draft control.

UNIT - IV: TURBINE MONITORING AND CONTROL (08 Periods)

Principal parts of steam turbine, Turbine measurements- Process parameters, Mechanical parameters, Electrical parameters, Turbine control system- safety control systems, process control systems, Lubrication system, Controls in lubrication system, Turbo alternator cooling system.

UNIT -V: POWER PLANT MAINTENANCE AND SAFETY (08 Periods)

Maintenance of measuring instruments- Types of maintenance, Maintenance costs, Life cycle costs, Intrinsic and electrical safety- Intrinsic safety of instruments, Electrical safety, Explosion hazards and intrinsic safety, Interlocks for boiler operation- safety interlocks, start- up and shut down interlocks.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOK:

1. K. Krishnaswamy, M. Ponni Bala, *Power Plant Instrumentation*, PHI, 2010.

REFERENCE BOOKS:

1. Patranabis, *Principles of Industrial Instrumentation*, Mcgraw Hill, 2nd Edition, 2001
2. A.R.Mallick, *Practical boiler operation engineering and power plant*, Denett & Co., 2nd Edition, 2010.

ADDITIONAL LEARNING RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc20_me10/preview
2. https://nptel.ac.in/courses/112/107/112107291/

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 Analog Electronics/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.

COURSEOUTCOMES: 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 — $180^0$and 120^0conduction 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, 6th 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*, 3rd Edition, Wiley, 2007.
2. Muhammad H. Rashid, *Power Electronics – Devices, Circuits and Applications*, 4th 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
(19BT60241) RENEWABLE ENERGY SOURCES
(Inter Disciplinary Elective-2)

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 various renewable energy sources, different energy conversion techniques, applications and environmental impacts of energy sources.

COURSEOUTCOMES: After successful completion of this course, the students will be able to:

CO1. understand the fundamental concepts of renewable energy sources and their endurance for sustainability.

CO2. understand the various methods of harvesting solar energy, energy conversion principles, and operational aspects and environmental impacts of solar technologies.

CO3. understand the various methods of harvesting wind and geothermal energy, energy conversion principles, and operational aspects and environmental impacts of wind and geothermal technologies.

CO4. understand the various methods of harvesting biomass energy, direct energy conversion technologies, and operational aspects and environmental impacts of biomass technologies.

CO5. understand the various methods of harvesting ocean energy, energy conversion technologies, and operational aspects and environmental impacts of ocean energy technologies.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO RENEWABLE ENERGY SOURCES (06 Periods)

Introduction, forms of energy, fundamentals of renewable and non-renewable energy sources & comparison; energy and environment—acid rain, ozone layer depletion, Global warming and greenhouse effect; renewable energy sources; renewable sources and their sustainable development.

UNIT-II: SOLAR ENERGY (12 Periods)

Introduction, solar constant, terrestrial and extra terrestrial solar radiations, solar radiation measurement instruments—pyranometers. Principles of solar radiation into heat, 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; environment benefits; Applications: solar pump, solar water heater.

UNIT-III: WIND ENERGY (08 Periods)

Introduction, power extraction from the wind, Wind turbines— horizontal axis wind turbine—propeller type and vertical axis wind turbine— darrieus rotor type & comparison; basic components of wind energy conversion system, Applications: energy storage, water pumping; environmental impacts.

UNIT-IV: Energy from biomass, fuel cell and geothermal resources (10 Periods)

Energy from Biomass: Introduction, biomass energy sources, Biomass conversion technologies— direct, thermochemical and biochemical conversions; biogas generation—anaerobic digestion process; Energy plantation, advantages of energy plantation.

Fuel cell: Introduction, principle and operation of fuel cell, classification of fuel cells, advantages and disadvantages of fuel cells.

Geothermal energy: Introduction, Geothermal resources, geothermal power plants—vapor dominated and liquid dominated; environmental issues.

UNIT-V: ENERGY FROM OCEANS (09 Periods)

Ocean Thermal Electric Conversion: Introduction, ocean thermal energy conversion (OTEC): open and closed cycle power plants.

Energy from Tides: Introduction, Basic principle of tidal power, schematic diagram of tidal power plant, advantages and limitations of tidal power generation.

Energy from waves: Introduction, wave energy conversion devices—floats, dolphin types, Advantages and disadvantages of wave energy.

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. G.N. Tiwari and M.K. Ghosal, *Renewable energy resources: Basic principles and applications*,Alpha Science International Ltd., 2005.

REFERENCE BOOKS:

1. JhonTwidell and Tony Wier, *Renewable Energy Resources*, Taylor & Francis, 2nd edition, London and Newyork, 2006.
2. K.M. Mittal,*Non-conventional Energy Systems-Principles*, Progress and Prospects, Wheeler Publications, 1997.
3. S.Rao, Dr.B.B. Parulekar, *Energy Technology*, Third edition, Khanna Publications, 2013.
4. R. K. Rajput, *A textbook of power system engineering*, Laxmi publications (P) Ltd, 2016

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108107112/
2. https://nptel.ac.in/courses/117105140/

III B. Tech. – II Semester

(19BT60341) BIOMECHANICS

(Inter Disciplinary Elective-2)

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

PRE-REQUISITES: -

COURSE DESCRIPTION: Basic Biomechanics is a first course in undergraduate biomechanics that provides background in musculoskeletal anatomy and principles of biomechanics. The course applies and builds on the concepts of Statics and Dynamics for human activities and Mechanics of Materials and tissues.

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

CO1. Demonstrate knowledge of principles of mechanics in biomechanical systems

CO2. Analyze the stresses and strains in biological tissues, given the loading conditions and material properties.

CO3. Calculate the effect of forces on human standing, sitting and lying postures.

CO4. Analyze the mechanical behavior of a given biological tissue using visco elasticity model.

CO5. Analyze the mechanical behavior of human motion and solve equations of motion for simple models of human movement.

UNIT-I : INTRODUCTION TO MECHANICS (09 Periods)

Review of the principles of mechanics, Vector mechanics- Resultant forces of Coplanar & Non-coplanar and Concurrent & non-concurrent forces, parallel forces in space, Equilibrium of coplanar forces, Newton's laws of motion, Work and energy, Moment of inertia.

UNIT-II: BIOMECHANICS OF JOINTS (09 Periods)

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle.

UNIT-III: APPLIED BIOMECHANICS (09 Periods)

Engineering approaches to standing, sitting and lying, Biomechanics of gait, application of gait and locomotion analysis, Fluid mechanics and energetics: Forms of energy and energy transfer.

UNIT-IV: MECHANICS OF HARD TISSUES (09 Periods)

Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, and Maxwell& Voight models – anisotropy.

UNIT-V: MECHANICAL ANALYSIS OF HUMAN MOTION (09 Periods)

Linear kinematics - Linear kinematic analysis - Position and displacement - Velocity andspeed - Acceleration - Differentiation and integration - Kinematics of running – Kinematicsof projectiles - Equations of constant acceleration.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. Nihat Ozkaya, *Fundamentals of biomechanics: Equilibrium, Motion and deformation*, 4th Edition, Springer Publications, 2017.
2. D. R. Peterson and J. D. Bronzino, *Biomechanics Principles and Applications*, CRC Press, USA, 2008.

REFERENCE BOOKS:

1. Roger Bartlett, *Introduction to Sports Biomechanics: Analysing Human Movement Patterns*, Taylor and Francis, 2007.
2. D. Dowson and V. Wright, *An introduction to Biomechanics of joints and joint replacements*, Mechanical Engineering Publications, 1980.

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: Courses on Numerical Methods, Probability and Statistics, Discrete Mathematical Structures, Design and Analysis of Algorithms.

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, Conceptlearning 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, Hypothesisspace 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, Gibbsalgorithm, Naive Bayes classifier, An Example – Learning to classify text; Bayesian belief networks, EMAlgorithm.

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. EthemAlpaydin, *Introduction to Machine Learning*, MIT Press, 4thEdition, 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
2. https://www.udemy.com/course/machinelearning/

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.

SOFTWARE/Tools used: -

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
(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^{th} Edition, 2002.

ADDITIONAL LEARNING RESOURCES:

1. 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

III B. Tech. – II Semester

(19BT61032) 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. Human Values and Professional Ethics by R R Gaur, R Sangal, G P Bagaria, Excel Books, New Delhi, 2010.

REFERENCE BOOK:

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 REQUISITE:-

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 disciples 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 BEHAVIOUR: 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, 16th 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, 10th edition, 2016.
2. Shashi K. Gupta and Rosy Joshi, *Organizational Behavior*, Kalyani Publications, 8th edition, 2017.

IV B. Tech. – I Semester

(19BT71001) BIOMEDICAL INSTRUMENTATION

(Common to ECE and EIE)

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

PRE-REQUISITE: A course on Electrical and Electronic Measurements, Industrial Instrumentation-1.

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 theraptic 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, Pnemuotachograph 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, Comparision between internal & external Pacemakers; Defibrillators: AC Defibrillator, DC Defibrillator, Synchronised DC Defibrillator; Diathermy: Shortwave and microwave, Dialysis: Hemo Dialysis, Peritonal 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

TEXT BOOKS:

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*", 3rd 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
3. https://nptel.ac.in

IV B. Tech. – I Semester

(19BT71002) PROGRAMMABLE LOGIC CONTROLLER

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 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*, 5th edition, PHI 2009.

REFERENCE BOOKS:

1. Frank D. Petruzella, *Programmable Logic Controller*, 3rd edition, Tata Mc-Graw Hill, 2010.
2. M.Chidambaram, *Computer Control of Process*, Narosa 2003.

ADDITIONAL LEARNING RESOURCES:

1. https//openautomationsoftware.com/use cases /allen bradley wpf scada/
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
(19BT70401) **EMBEDDED SYSTEMS**
(Professional Elective–4)
(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/Digital 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, 1st Edition, 2008.
2. Santanu Chattopadyay, 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

(19BT60410) **WIRELESS SENSOR NETWORKS**

(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 and Computer Networks.

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",* 1st Edition, CRC press 2003.
3. C.S.Raghavendra Krishna, M.Sivalingam and Taribznati, "*Wireless Sensor Networks*", Springer publication, 2006.

IV B. Tech. – I Semester

(19BT71003) AIRCRAFT INSTRUMENTATION

(Professional Elective–4)

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

PREREQUISITE: A Course on Industrial Instrumentation.

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 Tacho Generator/Indicator, Non-Contact type Tacho Probe, 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 andSystems*, I K International Publishing House Pvt. Ltd,2010

REFERENCE BOOK:

1. Pallett, E.H.J, *Aircraft Instruments and Integrated Systems*, Pearson igher 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

IV B. Tech. – I Semester

(19BT71004) COMPUTER CONTROL OF PROCESSES

(Professional Elective–4)

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

PRE-REQUISITE: Courses on Control Systems, Signals and Systems and Process Control Instrumentation.

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 student 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. Analyse various control strategies and identify mathematical model for various systems.

CO4. Asses 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–Dead beat 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–ModelbasedandMultivariableSystem,StatisticalProcessControl. 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 ofAmerica,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
4. www.nptel.ac.in/courses/103105064/

IV B. Tech. – I Semester
(19BT60403) ADVANCED DIGITAL 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: 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 student 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:PARA METRIC 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, 4th edition, 2007.
2. Sanjit K Mitra, "*Digital signal processing, A computer base approach",* McGraw-Hill Higher Education, 4th edition, 2011.

REFERENCE BOOKS:

1. Emmanuel C Ifeacher Barrie. W. Jervis, "*DSP-A Practical Approach*", Pearson Education, 2nd edition, 2002.
2. A.V. Oppenheim and R.W. Schaffer, "*Discrete Time Signal Processing",* PHI, 2nd edition, 2006.

IV B. Tech. – I Semester

(19BT71005) INSTRUMENTATION IN PROCESS INDUSTRIES

(Professional Elective–5)

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

PRE-REQUISITES: Courses on Control Systems, Process Control Instrumentation

COURSE DESCRIPTION: Description of the Process in Instrumentation in the Food Industry Paper Industry, Pharmaceutical Industry, Iron and Steel Industry, Petrochemical Industry**,**

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

CO1. Demonstrate knowledge on different process industries and the instruments used in those industries

CO2. Analyze the major process variables controlled in different Process Industries

CO3. Design various analyzers ,valves and feeders used in various process industries

CO4. Identify the most common types of sensing and measuring devices used in different process industries

DETAILED SYLLABUS:

UNIT-I: INSTRUMENTATION IN THE FOOD INDUSTRY (09 Periods)

Description of the Process, Measurement Hardware in the Food Industry, Analyzers in the Food Industry, Valves and Feeders in the Food Industry, Controllers and Displays in the Food Industry, Computer Applications in the Food Industry, Typical Control Systems in the Food Industry.

UNIT-II: INSTRUMENTATION IN THE PAPER INDUSTRY (09 Periods)

Description of the Process, Measurement Hardware in the Paper Industry, Analyzers in the Paper Industry, Valves and Feeders in the Paper Industry, Controllers and Displays in the Paper Industry, Computer Applications in the Paper Industry, Typical Control Systems in the Paper Industry.

UNIT-III: INSTRUMENTATION IN THE PHARMACEUTICAL INDUSTR (09 Periods)

Description of the Process, Measurement Hardware in the Pharmaceutical Industry, Analyzers in the Pharmaceutical Industry, Valves in the Pharmaceutical Industry, Controllers in the Pharmaceutical Industry, Computer Applications in the Pharmaceutical Industry, and Typical Control Applications in the Pharmaceutical Industry.

UNIT-IV: INSTRUMENTATION IN THE IRON AND STEEL INDUSTRY (09 Periods)
Description of the Process, Measurement Hardware in the Iron and Steel Industry, Analyzers in the Iron and Steel Industry, Valves in the Iron and Steel Industry, Controllers in the Iron and Steel Industry, Computer Applications in the Iron and Steel Industry, Typical Control Applications in the Iron and Steel Industry.

UNIT-V: INSTRUMENTATION IN THE PETROCHEMICAL INDUSTRY (09 Periods)
Control of Chemical Reactors, Computer Control of Batch Reactors, Control of Distillation Towers, Optimizing Control of Distillation Columns, Control of Furnaces, Control of Dryers, Control of Compressors.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOK:

1. Bela G. Liptak, *Instrumentation in Processing Industries*, Chilton Book Company, Canada, First Edition, 1973.

REFERENCE BOOK:

1. Bela G.Liptak, *Instrument Engineers Handbook on Process Control*, Chilton Book Company, Canada, Third Edition, 1999.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/103/107/103107081/
2. https://www.youtube.com/watch?v=RjZJjneJ5fk
3. https://nptel.ac.in/courses/103/105/103105064/

IV B. Tech. – I Semester

(19BT71006) IDENTIFICATION AND ADAPTIVE CONTROL

(Professional Elective–5)

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

PREREQUISITE: A course on Control Systems.

COURSE DESCRIPTION: Nonparametric identification methods for based on system response, frequency response and correlation, Time-invariant system identification for linear and nonlinear static and dynamic systems, Time-varying system identification for linear and nonlinear systems, Schemes of adaptive control.

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

CO1. Apply the system identification concepts to analyze the response of systems.

CO2. Apply the identification methods to model Time-Invariant static and dynamic systems.

CO3. Apply the identification methods to model Time-Variant static and dynamic systems.

CO4. Demonstrate the concepts of adaptive control.

DETAILED SYLLABUS:

UNIT-I: NONPARAMETRIC IDENTIFICATION (09 Periods)

Impulse response identification, step response identification, impulse response identification using step responses, sine-wave response identification, empirical transfer function identification, frequency analysis using correlation techniques.

UNIT-II: TIME-INVARIANT SYSTEM IDENTIFICATION-STATIC SYSTEM (09 Periods)

Linear static system: Linear regression, least-squares estimation, bias, accuracy, identifiability, errors-in-variables problem.

Nonlinear static system: nonlinear regression, nonlinear least-squares estimation, iterative solutions, accuracy, model reparameterization (static case), maximum likelihood estimation.

UNIT-III: TIME-INVARIANT SYSTEM IDENTIFICATION–DYNAMIC SYSTEM (09 Periods)

Linear dynamic system: transfer function models, equation error identification, output error identification, prediction error identification, model structure identification, subspace identification, linear parameter-varying model identification, orthogonal basis functions.

Nonlinear dynamic systems: simulation model, parameter sensitivity, nonlinear regressions, iterative solution, model reparameterization (dynamic case).

UNIT-IV: TIME-VARYING SYSTEM IDENTIFICATION (09 Periods)

Linear regression models: Recursive estimation, time-varying parameters, multi output case, resemblance with Kalman filter. Nonlinear static system: State-space representation extended Kalman filter.

Linear dynamic systems: Recursive least-squares estimation, recursive prediction error estimation, smoothing.

UNIT-V: ADAPTIVE CONTROL (09 Periods)

Indirect adaptive control structure, direct adaptive control structure, model reference adaptive control- MIT rule, MRAC using Lyapunov theory, direct and indirect deterministic self tuning regulator, stochastic self tuning regulators.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. Karel J Keesman, *System Identification: An Introduction*, Springer-Verlag London Limited, 2011
2. K.J.Astrom and B. Writtenmark, *Adaptive Control*, 2nd edition, Pearson Education, 2001.

REFERENCE BOOKS:

1. Shankar Sastry and Marc Bodson, *Adaptive Control: Stability, Convergence and Robustness*, PHI, New Jersey, 1989.
2. I.J. Nagrath and M. Gopal, *Control System Engineering*, 4th edition, New Age International Publishers, 2006.
3. Kannan M. Moudgalya, *Digital Control*, John Wiley & Sons, Ltd., 2007.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108102113/
2. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-435-system-identification-spring-2005/lecture-notes/
3. https://ocw.tudelft.nl/courses/system-identification-and-parameter-estimation/subjects/1-introduction-course-system-identification-parameter-estimation/

IV B. Tech. – I Semester

(19BT71007) BIOMEDICAL SIGNAL PROCESSING

(Professional Elective–5)

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

PRE-REQUISITES: Courses on Digital Signal Processing

COURSE DESCRIPTION: Analysis of Non-Stationary signals, noise & artifact removal, Advanced Signal processing techniques, Event Detection, Wavelet Transform.

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

CO1. Design filters to remove noise and artifacts from biomedical signals.

CO2. Develop algorithms to detect different events in biomedical signals.

CO3. Analyze biomedical signals in frequency domain.

CO4. Apply wavelet transform techniques to filter and denoise biomedical signals.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO BIOMEDICAL SIGNALS (09 Periods)

The nature of Biomedical Signals, sources of Biomedical Signals: The electromyogram, The electrocardiogram, The electroencephalogram, The electrogastrogram, The phonocardiograrn, The carotid pulse; objectives of Signal analysis, Difficulties in signal analysis, computer aided diagnosis, Heart sounds and murmurs.

UNIT-II: FILTERING FOR NOISE & ARTIFACT REMOVAL (09 Periods)

Illustration of noise removal with case studies, time and frequency domain filtering, Optimal Signal Processing: Wiener Filters, Adaptive Signal Processing, Adaptive Noise Cancellation, selecting an appropriate filter, Applications: Removal of Artifacts in the ECG, Maternal - Fetal ECG, Muscle-contraction Interference.

UNIT-III: EVENT DETECTION (09 Periods)

The P, QRS, and T waves in the ECG, The first and second heart sounds, The dicrotic notch in the carotid pulse, Derivative Based methods for QRS detection, Pan–Tompkins algorithm for QRS detection, Detection of Dicrotic notch, Correlation Analysis of EEG channels.

UNIT-IV: FREQUENCY-DOMAIN CHARACTERIZATION (09 Periods)

Illustration of the Problem with Case-studies, The Fourier Spectrum, Estimation of the Power Spectral Density Function, Measures Derived from PSDs, Application: Evaluation of Prosthetic Valves.

UNIT-V: WAVELET TRANSFORM (09 Periods)

Introduction and Overview, From FT to STFT, One-Dimensional Continuous Wavelet Transform, One-Dimensional Discrete Wavelet Transform, Discrete Wavelet Transform on Discrete Signals, Main Applications of DWT Filtering and Denoising, Compression.

Total Periods: *45*

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. Rangaraj M Rangayyan, *Biomedical Signal Analysis* –, IEEE Press, 2001.
2. Kayvan Najarian, Robert Splinter, *Biomedical Signal and Image Processing*, CRC Press, 2nd Edition 2012.

REFERENCE BOOK:

1. Willis J Tomkins, Biomedical Digital Signal Processing, PHI, 1993.

ADDITIONAL LEARNING RESOURCES:

1. NPTEL course on Biomedical signal processing.
2. Power point presentation by Rangaraj M Rangayyan on Biomedical signal processing.

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: A Course on Biomedical Instrumentation.

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:

3. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, "*Biomedical Instrumentation and Measurements*", 2nd Edition, PHI, 2003.
4. R.S. Khandpur, "*Hand Book of Biomedical Instrumentation*", Tata McGraw Hill, 2nd Edition, 2002.
5. John G.Webster, "*Medical Instrumentation Application and Design*", 3rd 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/

IV B. Tech. – I Semester

(19BT71032) **INDUSTRIAL AUTOMATION LAB**

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

PRE-REQUISITES: Process Control Instrumentation, Industrial Instrumentation, Programmable Logic Controllers.

COURSE DESCRIPTION: Automatic control of motors, liquid level, temperature & pressure processes using PLC based control systems and SCADA systems. P&I diagram of Feedback Control system and Cascade control system. Hydraulic and Pneumatic Systems.

COURSE OUTCOMES: After completion of this course student will be able to

CO1. Develop P& ID for different process control systems.

CO2. Design and Implementation of PLC programming for different areas of industrial automation.

CO3. Design and implementation of hydraulic and pneumatic circuits for industrial automation.

CO4. Function effectively as individual and as member in team in the field of industrial automation.

CO5. Communicate effectively both oral and written forms in the area of industrial automation.

LIST OF EXPERIMENTS

Minimum 11 experiments to be conducted

1. Study of various symbols and abbreviations used in P&ID diagram.
2. Draw the P&I diagram of Feedback Control System and Cascade Control System.
3. Implementation of Ladder Diagrams for Logic gates, timer and counters.
4. Programming a PLC to demonstrate control of a level Process.
5. Programming a PLC to demonstrate DC Motor speed control.
6. Programming a PLC to demonstrate Bottle filling system.
7. Programming a PLC to demonstrate Temperature control.
8. Implementation of PLC programming through SCADA.
9. Programming a PLC to demonstrate Pressure Control System.
10. Study of hydraulic components and hydraulic circuits.
11. Design of pressure and flow control valves using hydraulics.
12. Study of pneumatic components and technology.
13. Design of the interaction between cylinders & valves using pneumatics.

REFERENCE BOOKS:

1. John W. Webb & Ronald A. Reiss, *Programmable Logic Controllers Principles and Applications*, 5th edition, PHI 2009.
2. Frank D. Petruzella, *Programmable Logic Controller*, 3rd edition, Tata Mc-Graw Hill, 2010.
3. W. Bolton, *Programmable Logic Controllers* , 4th edition, Elsevier Newnes publication,2009.

Software/Tools used:

1. Computers.
2. Simulation software's – Auto Cad, Versa Max, Versa PRO, KV LADDER,X-logic, SCADA,HMI.
3. PLCs-Siemens, Allen Bradley, GE-Fanuc, X-logic.
4. Input/ Output devices- Sensors, Transducers, Push Buttons.

ADDITIONAL LEARNING RESOURCES:

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. http://www.plcmanual.com/

IV B. Tech. – I Semester

(19BT71033) **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�much‘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 this 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
(19BT710AC) **PROCESS PLANT LAYOUT AND PIPING DESIGN**
(Audit course)

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

PRE-REQUISITES: A Course on Process Control Instrumentation**.**

COURSE DESCRIPTION: Piping and Instrumentation Diagrams, Standards, Symbols, Pipes, Fittings, ASME codes.

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

CO1. Demonstrate piping and instrumentation diagrams, standards involved and its preparation.

CO2. Design pipes to industry requirements by applying ASME codes.

CO3. Select different fittings for instruments installation used for the preparation of piping and instrumentation diagrams.

CO4. Sketch piping and instrumentation diagrams per ASME codes to industry requirements.

DETAILED SYLLABUS:

UNIT-I: FUNDAMENTALS OF PROCESS PLANT LAYOUT (06 Periods)

Plant layout fundamentals, procedures and workflow methods used in process plant layout, Specifications, Physical quantities and units in plant layout.

Equipment Used in Process Plants: Introduction, Process equipment, Mechanical equipment (Towers and Reactors).

UNIT-II: FUNDAMENTALS OF PIPING SYSTEM (06 Periods)

Introduction to piping systems, Evolution of piping Manufacturing methods, Piping materials and selection, Pipe dimensioning, Schedule numbers, Common piping abbreviations, Major organizations for standards, Commonly American code in piping ASME/ANSI, Common abbreviations etc.

UNIT-III: TYPE OF FITTINGS, FLANGES & MAJOR VALVES (06 Periods)

Type of Fittings: Elbows, weld tee, stub in, couplings, reducers, weld cap, screwed and socket welded fittings, Pipe nipples, flanged fittings and use of fittings.

Type Flange: Types, P-T ratings and facings, Gaskets, bolts and nuts.

Major Valves: Types, valve symbols, Materials operations, applicability, codes and specifications.

UNIT-IV: PIPING ENGINEERING FLOW DIAGRAM AND ITS CONCEPT

(06 Periods)

Uses of flow diagrams, process flow diagrams, mechanical flow diagrams, utility, piping symbols, line symbols, piping isometrics general arrangement drawings-sections/elevations/ detail drawings plot plan procedures.

UNIT-V: PIPING AND INSTRUMENTATION DIAGRAM (P&ID) (06 Periods)

Fundamentals of P&ID, study of P&ID, stages of development of P&ID, process and instrumentation diagrams, process equipments, symbols usage according to industrial practices, Purpose of P&ID in process industrial/plants.

Total Periods: 30

Topics for self-study are provided in the lesson plan

TEXTBOOKS:

1. Ernest E.Ludwig, Applied Process Design for Chemical and Petrochemical Plants Vol-1, Gulf Publishing Company, Hoston, 1989.
2. Max. S. Peters and K.D.Timmerhaus, Plant Design and Economics for Chemical Engineers, McGraw Hill Inc., New York, 1991.

REFERENCES BOOKS:

1. Ed Bausbacher and Roger Hunt, "*Process Plant Layout and Piping Design",* Prentice Hall, 1st Edition, 1993.
2. "Process Piping: *The Complete Guide to ASME B31.3*", American Society of Mechanical Engineers, U.S., Third edition,2009.
3. Brownell, L.E. and Young, E.H., "*Process Equipment Design*", Wiley Eastern India Limited, 1991.
4. Peter Smith, "*The Fundamentals of Piping Design*", Gulf Publishing Company, 2013.
5. Stanley M Wales, "*Chemical Process equipment, selection and design*", Butterworths, series in Chemical Engineering, 1988.
6. Sean Moran, "*Process Plant Layout*", 2nd Edition, Butterworth-Heinemann, November 2016.

IV B. Tech. – II Semester

(19BT81031) **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 this course, the students will be able to:

CO1. Create/Design Electronics and Instrumentation Engineering or processes to solve complex civil 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 Instrumentation Engineering and allied problems.

CO3. Perform individually or in a team besides communicating effectively in written, oral and graphical forms on Electronics and Instrumentation Engineering systems or processes.

HONORS DEGREE

IN

ELECTRONICS AND INSTRUMENTATION ENGINEERING

(SVEC-19 Regulations)

Honors Degree in

ELECTRONICS AND INSTRUMENTATION ENGINEERING

COURSE STRUCTURE

<table>
<tr><th rowspan="2">Semester</th><th rowspan="2">Course code</th><th rowspan="2">Course title</th><th colspan="3">Contact Periods per week</th><th rowspan="2">C</th><th colspan="3">Scheme of Examination Max. Marks</th></tr>
<tr><th>L</th><th>T</th><th>P</th><th>Int. Marks</th><th>Ext. Marks</th><th>Total Marks</th></tr>
<tr><td rowspan="4">III B.Tech I-Sem. (2 Theory)</td><td>19BT51003</td><td>Advanced Sensors</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>19BT51004</td><td>Wearable sensors and its application</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>19BT51005</td><td>Digital Control Systems</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>19BT51006</td><td>Sensors and Actuators</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td rowspan="4">III B.Tech II-Sem. (2 Theory)</td><td>19BT61005</td><td>Smart sensors</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>19BT61006</td><td>Fractional Calculus and Control</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>19BT61007</td><td>MEMS Technology</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>19BT61008</td><td>Multisensor data fusion</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td rowspan="4">IV B.Tech I-Sem. (2 Theory)</td><td>19BT71008</td><td>Sensors for structural health monitoring</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>19BT71009</td><td>Wearable technology and IOT</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>19BT71010</td><td>Robust & Optimal Control</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td>19BT71011</td><td>Telemetry and Telecontrol</td><td>3</td><td>-</td><td>-</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
</table>

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

(19BT51003) **ADVANCED SENSORS**

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

PRE-REQUISITES: Courses on Engineering Physics, Electrical and Electronic Measurements.

COURSE DESCRIPTION: Working principle of Smart Sensors, MEMS sensors and wireless sensor networks; Applications of advanced sensors.

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

CO1. Demonstrate knowledge on smart sensors with their characteristics and design.

CO2. Illustrate in depth knowledge in micromaching and packaging techniques.

CO3. Develop wireless sensor networks for specified applications.

CO4. Identify and select an appropriate sensor for specific application.

DETAILED SYLLABUS:

UNIT–I: SMART SENSOR BASICS (09 Periods)

Introduction, Mechanical-Electronic Transitions in Sensing, Nature of sensors, Integration of Micromachining and Microelectronics, Application Example

UNIT–II: MICROMACHINING (09 Periods)

Introduction ,Bulk Micromachining- Silicon-on-Silicon Bonding, Silicon-on-Glass (Anodic) Bonding, Silicon Fusion Bonding, Wafer Bonding for More Complex Structures and Adding ICs. Wafer Bonding- Squeeze-Film Damping, Stiction, Particulate Control, Combinations of Surface and Bulk Micromachining Surface Micromachining- The LIGA Process, Dry Etching Processes, Micromilling. Lasers in Micromachining, Other Micromachining Techniques, Combining MEMS with IC Fabrication.

UNIT–III: MEMS BEYOND SENSORS & PACKAGING (09 Periods)

MEMS Actuators- Microvalve, Micromotors, Micropumps, Microdynamometer, Microsteam Engine. Micromachined Structures- Microoptics, Micromirrors, Thermionic Emitters, Micronozzles, Nanoguitar.

Semiconductor Packaging Applied to Sensors, Hybrid Packaging, Dual-Chip Packaging, Surface-Mount Packaging, Wafer-Level Packaging.

UNIT–IV: WIRELESS SENSING &ENERGY HARVESTING (09 Periods)

Wireless Sensing Networks, Industrial Wireless Sensing Networks, RF Sensing, RF-ID, Telemetry, RF MEMS, Application Example.

Applications Drive Technology Implementation and Development- Structural Health Monitoring, Building Automations Systems, Industrial Applications, EH Technologies

UNIT–V: SENSOR FUSION & NEXT PHASE OF SENSING SYSTEMS (09 Periods)

Sensors fusion, Fusion Software in the Sensor, Separate Fusion Software, Agnostic Sensor Fusion, Flexible Fusion

Sensor and Other Fusion Background, Sensor Fusion for Virtual Software, Simulation and Testing.

Future Sensor Plus Semiconductor Capabilities, Future System Requirements, Trusted Sensing, Alternate Views of Smart Sensing.

Note1: Unit wise periods may vary slightly, however total shall be 45.
Note2: For 2-credit courses, the total no. of periods shall be 30 (06 per Unit)

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. Randy Frank, Understanding Smart Sensors,3rd Edition.
2. Jacob Fraden, Handbook of modern sensors: physics, designs, and applications, Third edition.

REFERENCE BOOKS:

1. D. Patranabis – Sensor and Transducers (2e) Prentice Hall, New Delhi, 2003
2. Jain R.K., Mechanical and Industrial Measurements, Khanna Publishing, New Delhi, 10th Edition, 1992.
3. Liptak B.G, Process Measurement and Analysis, Volume-1, CRC press, 4th edition, 2003.

ADDITIONAL LEARNING RESOURCES:

Smart Sensor Basics:

https://www.mepits.com/tutorial/193/basic-electronics/smart-sensors
https://www.azosensors.com/article.aspx?ArticleID=1289

Bulk and Surface Micromachinig:

http://home.iitk.ac.in/~vkjain/MMPs_L1_Intro._010113.pdf
http://classweb.ece.umd.edu/enee416.F2009/GroupActivities/Report4.pdf

LIGA Process:

http://me.umn.edu/courses/me8254/attfiles/Lecture%2012%20LIGA_Full.pdf

Sensor Fusion:

https://www.sciencedirect.com/topics/engineering/sensor-fusion.
https://www.udacity.com/course/sensor-fusion-engineer-nanodegree--nd313

III B. Tech. – I Semester
(19BT51004) WEARABLE SENSORS AND ITS APPLICATION

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

PRE-REQUISITES: Transducers in Instrumentation

COURSE DESCRIPTION: Scope of Wearable Devices, Wearable Inertial Sensors, Wearable Devices for Healthcare, Wearable Biochemical and Gas Sensors, Wearable Cameras and Microphones for Navigation

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

CO1. Demonstrate knowledge on wearable devices and inertial sensors.

CO2. Apply wearable sensors for healthcare and navigation applications.

CO3. Design wearable devices for monitoring and detection of various parameters in health and industrial applications.

CO4. Analyze and synthesize the information to provide effective solution to engineering problems with warble sensors.

DETAILED SYLLABUS:

UNIT-I: SCOPE OF WEARABLE DEVICES (09 Periods)

Role of Wearables, Attributes of Wearables, The Meta Wearables – Textiles and clothing, Motivation for development of Wearable Devices, The emergence of wearable computing and wearable electronics, Types of wearable sensors: Invasive, Non-invasive; Intelligent clothing, Industry sectors' overview – sports, healthcare, Fashion and entertainment, military, environment monitoring, mining industry, public sector and safety

UNIT-II: WEARABLE INERTIAL SENSORS (09 Periods)

Wearable Inertial Sensors - Accelerometers, Gyroscopic sensors and Magnetic sensors; Modality of Measurement- Wearable Sensors, Invisible Sensors, In-Shoe Force and Pressure Measurement; Applications: Fall Risk Assessment, Fall Detection , Gait Analysis, Quantitative Evaluation of Hemiplegic and Parkinson's Disease patients. Physical Activity monitoring: Human Kinetics, Cardiac Activity, Energy Expenditure measurement: Pedometers, Actigraphs.

UNIT - III: WEARABLE DEVICES FOR HEALTHCARE (09 Periods)

Electrode – design, geometry, material; Fabrication of interdigitated (IDE) electrodes, choice of substrate, sensing film; Wearable Bioelectric impedance devices for Galvanic skin response; Wearable ECG devices: Basics of ECG and its design, Electrodes and the Electrode–Skin Interface; Wearable EEG devices: Principle and origin of EEG, Basic Measurement set-up, electrodes and instrumentation; Wearable EMG devices: EMG/ SEMG Signals, EMG Measurement – wearable surface electrodes, SEMG Signal Conditioning, Applications.

UNIT - IV: WEARABLE BIOCHEMICAL AND GAS SENSORS (09 Periods)

Wearable Biochemical Sensors: Parameters of interest, System Design –Textile based, Microneedle based; Types: Noninvasive Glucose Monitoring Devices, Gluco Watch® G2Biographer, Gluco TrackTM; Pulse oximeter, Portable Pulse Oximeters, wearable pulse oximeter; Wearable capnometer for monitoring of expired carbon dioxide. Wearable gas sensors: Metal Oxide (MOS) type, electrochemical type, new materials-CNTs, grapheme, Zeolites; Detection of atmospheric pollutants.

UNIT-V: WEARABLE CAMERAS AND MICROPHONES FOR NAVIGATION (09 Periods)

Cameras in wearable devices, Applications in safety and security, navigation, Enhancing sports media, Automatic digital diary. Cameras in smart-watches; Use of Wearable Microphones: MEMS microphones, Bioacoustics, Microphones and AI for respiratory diagnostics and clinical trials. Wearable Assistive Devices for the Blind - Hearing and Touch sensation, Assistive Devices for fingers and Hands, Assistive Devices for wrist, fore arm and feet, vests and belts, head-mounted devices.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOK:

1. "Seamless Healthcare Monitoring", Toshiyo Tamura and Wenxi Chen, Springer 2018
2. "Wearable Sensors -Fundamentals, Implementation and Applications", by Edward Sazonov and Michael R. Neuman, Elsevier Inc., 2014.

REFERENCE BOOKS

1. "Wearable Electronics Sensors - For Safe and Healthy Living", Subhas Chandra Mukhopadhyay, Springer 2015
2. M. Mardonova and Y. Choi, "Review of Wearable Device Technology and Its Applications to the Mining Industry," Energies, vol. 11, p. 547, 2018.
3. "Wearable and Autonomous Biomedical Devices and Systems for Smart Environment", by Aimé Lay-Ekuakille and Subhas Chandra Mukhopadhyay, Springer 2010

ADDITIONAL LEARNING RESOURCES:

1. https://www.te.com/usa-en/industries/sensor-solutions/applications/sensor-solutions-for-consumer-wearable-applications.html
2. https://innovatemedtec.com/digital-health/sensors-and-wearables
3. https://www.sciencedirect.com/topics/neuroscience/wearable-sensor
4. https://ieee-sensors.org/

III B. Tech. – I Semester
(19BT51005) DIGITAL CONTROL SYSTEMS

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

PRE-REQUISITES: A course on Control systems

COURSE DESCRIPTION: Discrete type control systems sample and hold circuits, signal flow graphs, controllability and Observability, digital controller design, state space analysis, and Digital state observer

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

CO1. Analyze sampling and quantization process in discrete time systems using z-transforms.

CO2. Analyze the performance and stability of discrete-time control systems.

CO3. Design digital controllers by applying matrix theory and transformation techniques.

CO4. Design state observers by applying matrix theory and transformation techniques.

DETAILED SYLLABUS:

UNIT- I: CONCEPT & REPRESENTATION OF DISCRETE TIME SYSTEMS (10 Periods)

Block Diagram of typical control system advantages of sampling in control systems – examples of discrete data and digital systems – data conversion and quantization – sample and hold devices – D/A and A/D conversion Mapping between the S-Plane and the Z-Plane, Pulse transfer function –relation between G(s) and G (z) – signal flow graph method applied to digital control systems.

UNIT-II: CONTROLLABILITY, OBSERVABILITY & STABILITY TESTS (10 Periods)

Concept of controllability, Observability and reachability - Controllability and Observability tests, Transformation of discrete time Systems into controllable and observable forms.

Stability: Definition of stability – stability tests – The second method of Liapunov. Stability improvement by state feedback discrete systems

UNIT-III: DESIGN OF DIGITAL CONTROLLER (09 Periods)

Digital Compensator Design using Frequency Response Plots, Digital Compensator Design using Root Locus Plots, z-Plane Synthesis, Lead, Lag and Lead-Lag compensators, Digital PID controller-Design with deadbeat response-Pole placement through state feedback

UNIT-IV: STATE SPACE ANALYSIS (09 Periods)

State Space Representation of discrete time systems, Pulse Transfer Function Matrix solving Discrete time state space equations, State transition matrix and its Properties, Methods for Computation of State Transition Matrix, Discretization of continuous time state – space equations.

UNIT-V: DIGITAL STATE OBSERVER (07 Periods)

Design of - Full order and reduced order observers. Design by max. Principle: Discrete Euler language equation-discrete maximum principle.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. Discrete Time Control systems by K. Ogata, Prentice Hall, Second Edition.
2. B. C. Kuo, Digital Control Systems, Oxford University Press, 2/e, Indian Edition

REFERENCE BOOKS:

1. Digital Control and State Variable Methods by M. Gopal, Tata McGraw Hill.
2. Digital Control by Kannan Moudgalya, John Wiley and Sons.

ADDITIONAL LEARNING RESOURCES:

1. https://ocw.mit.edu/courses/mechanical-engineering/2-171-analysis-and-design-of-digital-control-systems-fall-2006/
2. http://www.gvpcew.ac.in/LN-CSE-IT-22-32/EEE/4-Year/DCS.pdf
3. https://nptel.ac.in/courses/108/103/108103008/
4. http://www.engr.usask.ca/classes/EE/480/notes.html
5. https://eleccompengineering.files.wordpress.com/2015/03/digital-control-system.pdf
6. http://www.ece.mtu.edu/faculty/shiyan/EE4262Spring17/DigitalControlTextBook.pdf

III B. Tech. – I Semester
(19BT51006) **SENSORS AND ACTUATORS**

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

PRE-REQUISITES: A course on Process Control Instrumentation.

COURSE DESCRIPTION: Introduction, Magnetic Sensors, Linear actuators, Rotary actuators, Controls in NC Machines and fluidic control.

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

CO1. Demonstrate knowledge on Magnetic sensors and actuators.

CO2. Select an appropriate linear actuator for an industrial requirement.

CO3. Select an appropriate rotary actuator for an industrial requirement.

CO4. Demonstrate knowledge on Numeric Control machines and fluidic control.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION (09 Periods)

Introduction - classification of sensors and actuators, magnetic sensors, linear and latching solenoid actuators, stepper motors, special magnetic devices, rotary and linear actuators. Magnetic Materials and Technology - soft magnetic materials, hard magnetic materials, coating technologies, magnetic materials market and applications.

UNIT-II: MAGNETIC SENSORS (08 Periods)

Magnetic Sensors- Theory of magnetic sensors, magnetic sensor analysis, VR sensors, solid state sensors, magnetic sensor applications, magnetic speed sensor requirements, magnetic speed sensor applications, magnetic position sensor applications, VR sensor noise.

UNIT-III: LINEAR ACTUATORS (08 Periods)

Linear Actuators - Mathematical model for linear actuators, Fast acting actuators. Disk Solenoids, plunger solenoids, ball solenoids, conical solenoids, applications of solenoid actuators, Long stroke solenoid fuel pump, gasoline injectors, natural gas injectors, diesel fuel injectors, compressor solenoid valves, transmission solenoids.

UNIT-IV: ROTARY ACTUATORS (11 Periods)

Rotary Actuators - disk rotary actuators, disk Rotary actuator analysis, disk rotary actuator design, disk rotary actuator excitation electromagnetic circuit, disk rotary actuator toothed magnetic part, disk rotary actuator PM, claw pole rotary actuators, claw Pole rotary actuator analysis, claw pole rotary actuator design, claw pole rotary actuator excitation electromagnetic circuit , claw pole actuator toothed magnetic part, claw pole actuator PM, cylindrical rotary actuators, cylindrical rotary actuator PM, cylindrical rotary actuator excitation electromagnetic circuit, cylindrical rotary actuator toothed magnetic structure, rotary actuator applications, disk rotary actuator application, claw pole rotary actuator application – cylindrical rotary actuator application.

UNIT-V: CONTROLS IN NC MACHINES AND FLUIDIC CONTROL (09 Periods)

Controls in NC Machines and Fluidic Control, stepping motors, feedback devices, encoders, resolvers, inductosync –tachogenerators, principles of fluid logic control, Co and a effect, basic fluidic devices, fluidic logic gates, bistable flip-flop, OR and NOR gates, exclusive OR gates, fluidic sensors, backpressure sensor, cone jet proximity sensor, interruptible jet sensor.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. Andrzej M. Pawlak, "Sensors and Actuators in Mechatronics, Design and Applications", Taylor & Francis Group, 2006.

REFERENCE BOOKS:

1. Andrew Parr, "*Hydraulics and Pneumatics* ", Jaico Publishing House, Mumbai, 2013.
2.Robert .Bishop, "*Mechatronic systems, Sensors and Actuators Fundamentals and Modelling"*, Taylor & Francis Group, 2007.

ADDITIONAL LEARNING RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc19_ee41/preview
2. https://nptel.ac.in/courses/108/108/108108147/

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: Courses on Transducers in Instrumentation, Industrial Instrumentation.

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 Deynega , "*Data Acquisition and Signal Processing for Smart Sensors*", John Wiley & Sons Ltd, 1st edition, 2002.
2. Jacob Fraden , "*Handbook of Modern Sensors: Physics, Designs, And Applications*", Springer, 5thedition, 2016.
3. Randy Frank, "*Understanding Smart Sensors*", Artech House, 3rd Edition, 2013.

REFERENCE BOOKS:

1. Sergio Franco, *"Design with Operational Amplifiers and Analog Integrated Circuits",* McGraw-Hill Education, 4th edition, 2015.
2. G.K. Anantha suresh K.J. Vinoy S. Gopala krishnan K.N. Bhat V.K. Aatre, "*Micro and Smart Systems: Technology and Modeling*", John Wiley & Sons, Inc., 1st edition, 2012.

ADDITIONAL LEARNING RESOURCES:

1. **Smart sensors:**

   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

2. **MEMS Technologies: Photolithography**

   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
(19BT61006) FRACTIONAL CALCULUS AND CONTROL

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

PRE-REQUISITES: A course on Control systems.

COURSE DESCRIPTION: Fractional calculus, Fractional-order differential equations and modeling, linear fractional-order systems, fractional-order control.

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

CO1. Demonstrate knowledge on fractional calculus

CO2. Design fractional order model for linear and non-linear systems

CO3. Analyze the response of fractional order control in time domain and frequency domain

CO4. Design Fractional order compensators for physical systems

DETAILED SYLLABUS:

UNIT-I: FRACTIONAL CALCULUS (09 Periods)

Review of basic definitions of integer-order (IO) derivatives and integrals and their geometric and physical interpretations, Definition of Riemann-Liouville (RL) integration, Definitions of RL, Caputo and Grunwald - Letnikov (GL) fractional derivatives (FDs), Various geometrical and physical interpretations of these FDs, Computation of these FDs for some basic functions like constant, ramp, exponential, sine, cosine, etc., Laplace and Fourier transform of FDs.

UNIT-II: FRACTIONAL-ORDER DIFFERENTIAL EQUATION (09 Periods)

Study of basic functions like Gamma function, Mittag-Leffler function, Dawson's function, Hyper geometric function, etc, Analysis of linear fractional-order differential equations (FDEs): formulation, Solution with different FDs, Initial conditions, Problem of initialization and the remedies.

UNIT-III: FRACTIONAL-ORDER MODELING (10 Periods)

Concepts of memory and non-locality in real-world and engineering systems, non-exponential relaxation, 'Mittag-Leffler' type decay and rise, Detailed analysis of fractional-order (FO) modeling of: electrical circuit elements like inductor, capacitor, electrical machines like transformer, induction motor and transmission lines, FO modeling of viscoelastic materials, concept of fractional damping, Models of basic circuits and mechanical systems using FO elements, Concept of anomalous diffusion, non-Gaussian probability density function and the development of corresponding FO model, FO models of heat transfer, A brief overview of FO models of biological systems.

UNIT-IV: LINEAR FRACTIONAL-ORDER SYSTEMS: (09 Periods)

Review of basic concepts of complex analysis, Concepts of multi valued functions, branch points, branch cuts, Riemann surface and sheets, Fractional-order transfer function (FOTF) representation, Concepts like commensurate and non-commensurate TFs, stability, impulse, step and ramp response, Frequency response, non-minimum phase systems, Root locus, FO pseudo state-space (PSS) representation and the associated concepts like solution of PSS model, controllability, observability, etc.

UNIT-V: FRACTIONAL-ORDER CONTROL: (08 Periods)

Detailed discussion and analysis of superiority of FO control over the conventional IO control in terms of closed-loop performance, robustness, stability, etc., FO lead-lag compensators, FO PID control, design of FO state-feedback, Realization and implementation issues for FO controllers, survey of various realization methods and the comparative study.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. K.B.Old hamand, J.Spanier, *"The FractionalCalculus*", Dover Publications, USA, 2006.
2. Kilbas, H. M. Srivastava and J. J. Trujillo, *"Theory and Applications of Fractional Differential Equations"*, Elsevier, Netherlands, 2006.
3. Podlubny, *"Fractional Differential Equations"*, Academic Press, USA, 1999.

REFERENCE BOOKS:

1. C. A. Monje, Y. Q. Chen, B. M. Vinagre, D. Xue, and V. Feliu, *"Fractional-order Systems and Control:Fundamentals and Applications",* Springer-Verlag London Limited, UK, 2010.
2. R.L.Magin, *"Fractional Calculus in Bioengineering"*, Begell House Publishers, USA, 2006.
3. R.Caponetto, G.Dongola, L.Fortuna and I.Petras, *"Fractional Order Systems: Modeling and Control Applications,* World Scientific, Singapore, 2010.

ADDITIONAL LEARNING RESOURCES:

1. https://onlinecourses.nptel.ac.in/noc21_ma14/preview
2. https://onlinecourses.nptel.ac.in/noc21_ee05/preview

III B. Tech. – II Semester
(19BT61007) MEMS TECHNOLOGY

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

PRE-REQUISITES: Industrial Instrumentation, sensors and Transducers

COURSE DESCRIPTION: Overview of Micro Electro Mechanical Systems (MEMS); scaling laws; working principles of micro sensors and micro actuators; materials; micro fabrication processes; packaging of Microsystems, Bio MEMS, RF MEMS.

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

CO1. Demonstrate knowledge on MEMS devices, scaling laws, micro sensors and micro actuators.

CO2. Analyze the properties of materials and identify its suitability for MEMS devices.

CO3. Design MEMS devices that meet desired specifications and requirements in engineering, biomedical and RF applications.

CO4. Analyze and synthesize the information to provide effective solution to engineering problems with MEMS devices.

DETAILED SYLLABUS:

UNIT-I: OVERVIEW OF MEMS AND SCALING LAWS (09 Periods)

MEMS and Microsystems, Microsystems and microelectronics, miniaturization, applications of MEMS in the automotive industry and in other industries. Scaling laws of miniaturization: Introduction to scaling, scaling in: geometry, rigid- body dynamics, electrostatic forces, electromagnetic forces, Electricity, Fluid mechanics, Heat transfer.

UNIT-II: WORKING PRINCIPLES OF MICROSYSTEMS (09 Periods)

Micro sensors, acoustic wave sensors, biomedical and biosensors, chemical sensors, pressure sensors, thermal sensors. Micro actuation: actuation using thermal forces, shape-memory alloys, piezoelectric crystals, electrostatic forces. MEMS with micro actuators, micro grippers, micro motors, micro valves, micro pumps. Micro accelerometers, micro fluidics.

UNIT - III: MICRO SENSORS &MEMS Sensors: (07 Periods)

Design of Acoustic wave sensors, resonant sensor, Vibratory gyroscope, MEMS accelerometers Capacitive and Piezo Resistive Pressure sensors- engineering mechanics behind these Micro sensors. Case study: Piezo-resistive pressure sensor

UNIT - IV: INTRODUCTION TO MICROSYSTEMS - BIO MEMS (10 Periods)

Introduction to Microsystems - BioMEMS - Evolution of Micro fabrication - Introduction to Nanotechnology – Definition of Silicon micro fabrication techniques such as photolithography(high resolution),Ion Implantation, oxidation, diffusion, sputtering, epitaxial growth and etching-Design of flow processes in bulk manufacturing-surface micro machining- LIGA process –EFAB fabrication-Micro system packaging

UNIT - V: INTRODUCTION TO RF MEMS (10 Periods)

Introduction to RF MEMS, , Electrical and mechanical modelling of MEMS devices, MEMS Switches: Introduction to MEMS switches; Capacitive shunt and series switches: Physical description, circuit model and electromagnetic modelling; Techniques of MEMS switch fabrication and packaging; Design of MEMS switches. RF Filters and Phase Shifters: Modelling of mechanical filters, micro machined filters, surface acoustic wave filters, micro machined filters for millimetre wave frequencies

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXTBOOK:

1. "MEMS & Microsystems, Design and Manufacture", Tai-Ran Hsu McGraw Hill Education (India) Pvt. Ltd., 2002.

REFERENCE BOOKS

1. G.K.Ananthasuresh, K.J.Vinoy, Micro and Smart Systems, Wiley India, 2010.
2. Nitaigour Premchand Mahalik, MEMS, McGraw Hill Education (India) Pvt. Ltd., 2007.

ADDITIONAL LEARNING RESOURCES:

1. https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-777j-design-and-fabrication-of-microelectromechanical-devices-spring-2007/
2. https://nptel.ac.in/courses/117/105/117105082/
3. https://nptel.ac.in/courses/112/104/112104181/

III B. Tech. – II Semester
(19BT61008) **MULTISENSOR DATA FUSION**

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

PRE-REQUISITES: Courses on Advanced Control Systems.

COURSE DESCRIPTION: Sensors and sensor data, multiple sensors, data fusion, algorithms, taxonomy of algorithms for multisensor data fusion, filtering, information filtering, optimal sensor fusion and high performance data structures.

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

CO1. Demonstrate knowledge on data fusion.

CO2. Identify and characterise the principle components of data fusion and information systems.

CO3. Apply the concepts of data fusion in sensing.

CO4. Select fusion techniques appropriate to system and mission needs.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO MULTISENSOR DATA FUSION (09 Periods)

Introduction, sensors and sensor data, use of multiple sensors, fusion applications, the inference hierarchy: output data, data fusion model,architectural concepts and issues, benefits of data fusion, limitations of data fusion.

UNIT-II: MATHEMATICAL TOOLS (09 Periods)

algorithms, co-ordinate transformations, rigid body motion, dependability and markov chains, meta – heuristics, taxonomy of algorithms for multisensor data fusion, data association, identity declaration.

UNIT-III: INTRODUCTION TO THE KALMAN FILTER (09 Periods)

Estimation: kalman filtering, practical aspects of kalman filtering, extended kalman filters, decision level identify fusion, knowledge based approaches.

UNIT-IV: DATA INFORMATION FILTER AND SENSOR FUSION (09 Periods)

Data information filter, extended information filter, decentralized and scalable decentralized estimation, sensor fusion and approximate agreement, optimal sensor fusion using range trees recursively, distributed dynamic sensor fusion.

UNIT-V: HIGH PERFORMANCE DATA STRUCTURES (09 Periods)

High performance data structures: tessellated, trees, graphs and function, representing ranges and uncertainty in data structures, designing optimal sensor systems with in dependability bounds, implementing data fusion system.

Total Periods: *45*

Topics for self-study are provided in the lesson plan

TEXT BOOKS:

1. David L. Hall,Sonya A H McMullen, Mathematical techniques in Multisensor data fusion, Artech House, Boston, 2nd Edition, 2004.
2. R.R. Brooks and S.S.Iyengar, Multisensor Fusion: Fundamentals and Applications with Software, Prentice Hall Inc., New Jersey, 1998.
3. Jitendra R.Raol, Multi sensor data fusion with MATLAB, CRC Press, 2010.

REFERENCE BOOKS:

1. 1. Arthur Gelb, Applied Optimal Estimation, M.I.T. Press, 1982.
2. 2. James V. Candy, Signal Processing: The Model Based Approach, McGraw –Hill Book Company, 1987.

ADDITIONAL LEARNING RESOURCES:

https://www.coursera.org/lecture/state-estimation-localization-self-driving-cars/lesson-2-multisensor-fusion-for-state-estimation-2imn3

https://pe.gatech.edu/courses/multi-sensor-data-fusion
https://iopscience.iop.org/article/10.1088/2631-7990/ab7ae6/pdf
https://link.springer.com/chapter/10.1007/978-3-319-32552-1_35

IV B. Tech. – I Semester
(19BT71008) SENSORS FOR STRUCTURAL HEALTH MONITORING

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

PRE-REQUISITES: A course on Transducers in Instrumentation.

COURSE DESCRIPTION: Structural Health Monitoring, various applications, technical challenges, Vibration based Techniques, piezoelectric sensors, fiber optic sensors, low frequency electromagnetic techniques, capacitive methods for SHM.

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

CO1. Demonstrate knowledge on structural health monitoring for various applications

CO2. Analyze the vibration based detection techniques forstructural health monitoring

CO3. Select an appropriate piezoelectric sensor for structural health monitoring applications

CO4. Select an appropriate fiber optic sensor for structural health monitoring applications

CO5. Apply Low Frequency Electromagnetic techniques and capacitive methods for structural health monitoring in Civil Engineering applications

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION (11 Periods)

Need for structural health monitoring, technical challenges, potential applications in civil, naval, aerospace and manufacture engineering, Definition of damage, structural measurements, overview of smart materials.

UNIT-II: VIBRATION BASED TECHNIQUES FOR SHM (09 Periods)

Basic vibration and modal analysis- Frequency domain methods, time domain methods, mode shape methods. Limitations of vibration based damage detection techniques.

UNIT-III: SHM USING PIEZOELECTRIC SENSORS ANDELECTRICAL RESISTANCE (08 Periods)

Lamb wave structure interrogation, sensor technology, localized damage with guided waves in composite materials, electro-mechanical impedance in defect detection in metallic and composite parts.

Composite damage, electrical resistance of unloaded composite, influence of temperature, composite strain and damage monitoring, piezoresistivity and strain sensing, damage localization, Corrosion sensors.

UNIT-IV: FIBER OPTIC SENSORS **(08 Periods)**

Intensity based, phased modulated or interferometers, wavelength based or Fiber Bragg gratings.FBG as strain and temperature sensor, FBG's as damage sensors for composites, applications in aeronautics and civil engineering.

UNIT-V: LOW FREQUENCY ELECTROMAGNETIC TECHNIQUES **(09 Periods)**

Maxwell's equation, dipole radiation, surface impedance, diffraction, eddy current, polarization of dielectrics. Applications to NDE/NDT domain, Application to SHM domain-magnetic method,electric method, hybrid method.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOK:

1. Daniel Balageas, Claus-Peter Fritzen and Alfredo Guemes, *"Structural Health Monitoring"*, 2010,John Wiley & sons, USA.

REFERENCE BOOKS:

1. Victor Giurgiutiu, "Structural *Health Monitoring with Piezoelectric wafer Active Sensors*", 2014, 2nd edition, Academic Press, USA.
2. Branko Glisic, Daniele Inaudi, *"Fiber Optic Methods for Structural Health Monitoring*", 2008, Wiley, USA.
3. D Huston, *"Structural Sensing, Health Monitoring and Performance Evaluation"*, 2010, CRC Press, USA.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/105/105/105105166/
2. https://www.youtube.com/watch?v=wcO591deLNg

IV B. Tech. – I Semester
(19BT71009) **WEARABLE TECHNOLOGY AND IOT**

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

PREREQUISITES: Microcontrollers and Embedded Systems.

COURSE DESCRIPTION: IOT functional requirements, Role of IOT in wearable devices, IOT supported technologies, Network Fundamentals, Application Protocols.

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

CO1. Demonstrate knowledge on evolution of IoT and its functional modules

CO2. To analyse and select appropriate protocols, wireless techniques for the problem

CO3. Design and develop IoT end points for wearable applications.

CO4. To identify the real world problem and give IoT solutions.

DETAILED SYLLABUS:

UNIT-I: IOT ARCHITECTURE (09 Periods)

IoT functional requirements, building blocks, IoT architecture layers, cloud and fog based architecture, M2M-Machine to Machine architecture, Web of Things, physical layer, MAC layer,6LoWPAN security aspects in IoT.

UNIT-II: ROLE OF IOT IN WEARABLE DEVICES (09 Periods)

Smart connectivity and Big picture of IoT-smart devices, Networks, Wireless Technologies and need for data analysis. Evolution of wearable technology, Wearable IoT use cases- Smart watches , Android wear, Smart glasses, fitness trackers, health care devices, cameras, smart clothing.

UNIT-III: IOT SUPPORTED TECHNOLOGIES (09 Periods)

OSI model, data transfer referred with OSI model, IP Addressing, point to point data transfer, point to multi point data transfer & network topologies, sub-nets, network topologies referred with web, introduction to web servers and cloud computing.

UNIT-IV: IOT SUPPORTED TECHNOLOGIES: HARDWARE PLATFORMS (9 Periods)

Overview of single board computers (Raspberry pi/Beag1e bone black), ARM Cortex Processors, NodeMCU .Network Fundamentals: Overview and working principle of wired and wireless networking equipment's -router, switches, accesspoints, and hubs. Networking configurations in Linux accessing hardware & device files interactions.

UNIT-V: WEARABLE IOT **(09 Periods)**

Application Protocols: MQTT, REST/HTTP, CoAP. Case studies: Health care, fitness and sports, industrial, defence and security, home automation, gaming.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOK:

1. Alessandro Bassi, Martin Bauer, Martin Fiedler, Thorsten Kramp, Rob van Kranenburg,Sebastian Lange, Stefan Meissner, "Enabling things to talk — Designing IoT solutions with the IoT Architecture Reference Model", Springer Open, 2013.

REFERENCE BOOKS:

1. The Internet of Things: How Smart TVs, Smart Cars, Smart Homes, and Smart Cities Are Changing the World 1st Edition.
2. Jan Holler, VlasiosTsiatsis, Catherine Mulligan, StamatisKamouskos, Stefan Avesand, David Boyle, "From Machine to Machine to Internet of Things", Elsevier Publications, 2014.
3. Edward Sazonov, Michael R. Neuman (editors), Wearable Sensors: Fundamentals, Implementation and Applications, Academic Press/Elsevier,2014.

ADDITIONAL LEARNING RESOURCES

1. https://www.sciencedirect.com/science/article/abs/pii/S0924424720306361
2. https://www.nature.com/articles/s41746-019-0150-9
3. https://www.frontiersin.org/articles/10.3389/fdgth.2020.00008/full

IV B. Tech. – I Semester
(19BT71010) ROBUST & OPTIMAL CONTROL

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

PREREQUISITE: Courses on Modern Control Theory, Differential Equations and Multivariable Calculus.

COURSE DESCRIPTION: Model Uncertainty and Robustness, Robust Performance and Performance Assessment, Optimal Control Problems and Performance Measures, Calculus of Variation, Variational Approach to Optimal Problems.

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

CO1. Demonstrate knowledge on uncertainity and robustness of a system.

CO2. Develop mathematical model for a robust and optimal control system.

CO3. Analyze the behavior of control systems in terms of performance parameters and stability.

CO4. Design Optimal Controller to achieve required stability, performance and Robustness.

DETAILED SYLLABUS:

UNIT-I: MODEL UNCERTAINTY AND ROBUSTNESS (09 Periods)

Norms for signals and systems, model uncertainty, small gain theorem, Robust stability, Stability under unstructured uncertainties, Robust performance, Deficiencies of classical control for MIMO systems.

UNIT-II: ROBUST PERFORMANCE AND PERFORMANCE ASSESSMENT (09 Periods)

Robust loop shaping and frequency response methods, Performance in the presence of uncertainty, robust pole placement design for robust performance.

UNIT-III: OPTIMAL CONTROL PROBLEMS AND PERFORMANCE MEASURES (09 Periods)

The mathematical model of a process, physical constraints, statement of optimal control problem, problem formulation and forms of optimal control, selection of performance measures.

UNIT-IV: CALCULUS OF VARIATION **(09 Periods)**

Fundamental concepts, Maxima and Minima of functions - extremum functionals involving single and several independent functions, Fundamental theorem of calculus of variations, piecewise smooth extremals, constrained extrema.

UNIT-V: VARIATIONAL APPROACH TO OPTIMAL PROBLEMS **(09 Periods)**

Necessary conditions for optimal control, Pontriyagin's minimum principle, state inequality constraints, minimum time problem, minimum control effort problems.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. L.Fortuna, M.Frasca(Eds), ''Optimal and Robust Control'', CRC press, 2012.
2. D.E.Kirk, Optimal Control Theory-An Introduction, Dover Publications, New York, 2012.
3. K.Zhou, J.C. Doyle and Glover, ''Robust and Optimal control'', Prentice Hall, 1996.

REFERENCE BOOKS:

1. Katruhiko Ogata, *Modern Control Engineering*, Prentice Hall of India Ltd, Fifth Edition, 2010.
2. Michael Athans and Peter L. Falb, *Optimal Control: An Introduction to the Theory and Its Applications*, Dover Publications, New York, 2007.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/107/108107098/
2. https://nptel.ac.in/courses/115/108/115108104/
3. https://web.iitd.ac.in/~subashish/ELL804.html
4. https://fdocuments.in/reader/full/robust-and-optimal-control-zhou

IV B. Tech. – I Semester
(19BT71011) **TELEMETRY AND TELECONTROL**

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

PREREQUISITE: A Course on Principles of communication.

COURSE DESCRIPTION: Different Telemetry Principles; Frequency and Time-division Multiplexed Systems; Satellite Telemetry; Optical Telemetry and Telecontrol Methods.

COURSE OUTCOMES: After Successful completion of this course the students are able to:

CO1. Demonstrate knowledge on different Telemetry Principles, Satellite Telemetry and Optical Telemetry.

CO2. Critically analyze the Telecontrol requirements to meet the specifications.

CO3. Design transmitter and receiver circuits for data transmission.

CO4. Analyze and solve errors during transmission.

CO5. Apply appropriate telemetry principles for data transmission in real time.

DETAILED SYLLABUS:

UNIT – I: TELEMETRY FUNDAMENTALS AND CLASSIFICATION (09 Periods)
Fundamental concepts, Significance, Principle, functional blocks of Telemetry and Telecontrol system; Methods of telemetry: Electrical, Pneumatic, Hydraulic and Optical Telemetry; State of the art; Telemetry standards.

UNIT – II: LANDLINE TELEMETRY (09 Periods)
Electrical Telemetry: Current Systems, Voltage Systems; Synchro Systems; Frequency systems, Position and Pulse systems; Example of a landline telemetry system.

UNIT – III: BIO TELEMETRY (09 Periods)
Introduction to Biotelemetry: Physiological parameters adaptable to Biotelemetry, Components of Biotelemetry Systems, Implantable Units, Applications of Telemetry in Patient Care

UNIT – IV: OPTICAL TELEMETRY (09 Periods)
Optical fibers for signal transmission: Sources for fiber optic transmission, Optical detectors, trends in fiber, optic device development , Example of an optical telemetry system.

UNIT – V: TELECONTROL METHODS **(09 Periods)**

Analog and Digital techniques in telecontrol: telecontrol apparatus, Remote adjustment, Guidance and regulation; Telecontrol using information theory; Example of a telecontrol system.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. D. Patranabis, *Telemetry Principles*, TMH, 2003.
2. Swoboda G., *Telecontrol Methods and Applications of Telemetry and Remote Control*, Reinhold Publishing Corp., London, 1991.

REFERENCE BOOK:

1. Leslie Cromwell, Fred. J. Weibell and Erich. A. Pfeiffer, *Biomedical Instrumentation and Measurements*, 2nd edition, PHI, 2003.

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 &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 (2 Theory + 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 Lab	-	-	2	2	1	50	50	100
III B.Tech. II-Sem (2 Theory + 1 Lab)	19BT70502	Data Science	3	-	-	3	3	40	60	100
	19BT60507	Nature Inspired Algorithms	3	-	-	3	3	40	60	100
	19BT60502	Machine Learning	3	-	-	3	3	40	60	100
	19BT60531	Machine Learning Lab	-	-	2	2	1	50	50	100
IV B.Tech. I-Sem (1 Theory + 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 therespective 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, 4th Edition, 2020.

REFERENCE BOOKS:

1. Stephen Lucci, Danny Kopec, *Artificial Intelligence in the 21st Century*, Mercury Learning and Information, 3rd Edition, 2018.
2. Rich, Knight, Nair, *Artificial intelligence*, Tata McGraw Hill, 3rd Edition, 2009.
3. Deepak Khemani, *A First Course in Artificial Intelligence*, McGraw Hill, 2017.
4. Saroj Kaushik, *Artificial Intelligence,* Cengage Learning, 2011.

ADDITIONAL RESOURCES:

1. https://searchenterpriseai.techtarget.com/definition/AI-Artificial-Intelligence
2. http://aima.cs.berkeley.edu/
3. https://ai.google/education/
4. https://www.coursera.org/courses?query=artificial%20intelligence
5. 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, 3rd 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:

1. 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, 2nd Edition, 2017.

REFERENCE BOOKS:

1. Sinan Ozdemir, *Principles of Data Science*, Packt Publishers, 2nd Edition, 2018.
2. John Paul Mueller, Luca Massaron, Python for Data Science for Dummies, 2nd Edition, Wiley, 2015.
3. Rachel Schutt, Cathy O'Neil, *Doing Data Science: Straight Talk from the Frontline*, O'Reilly, 2014.

ADDITIONAL LEARNING RESOURCES:

1. https://swayam.gov.in/nd1_noc19_cs60/preview
2. https://towardsdatascience.com/
3. https://www.w3schools.com/datascience/
4. https://github.com/jakevdp/PythonDataScienceHandbook
5. 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 (xslx) 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, 2nd Edition,2017.
2. John Paul Mueller, Luca Massaron, Python for Data Science For Dummies, 2nd Edition, Wiley, 2015.

SOFTWARE/TOOLS:

- Python 3.8
- Python Libraries – NumPy, Pandas, Matplotlib,
- Anaconda Framework

ADDITIONAL LEARNING RESOURCES:

1. https://swayam.gov.in/nd1_noc19_cs60/preview
2. https://towardsdatascience.com/
3. https://www.w3schools.com/datascience/
4. https://github.com/jakevdp/PythonDataScienceHandbook
5. 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, 2nd Edition, 2014.

REFERENCE BOOKS:

1. Wes McKinney, *Python for Data Analysis*, O'Reilly, 2nd 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:

1. https://swayam.gov.in/nd1_noc19_cs60/preview
2. https://towardsdatascience.com/
3. https://www.w3schools.com/datascience/
4. https://github.com/jakevdp/PythonDataScienceHandbook
5. 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: -

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, 2nd 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:

1. Xin-She Yang, *Nature-Inspired Computation and Swarm Intelligence: Algorithms, Theory and Applications,* Elsevier, 2020.
2. 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, 4th 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
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: A Course on 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, 3rd Edition, 2019.
2. Aurelien Geron, *Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow: Concepts, Tools, and Techniques to Build Intelligent Systems*, 2nd 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: -

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*, 4th Edition, MIT Press, 2016.

REFERENCE BOOKS:

1. Kevin P. Murphy, "*Machine Learning: A Probabilistic Perspective*", MITPress,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
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, 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 Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
III B.Tech. I-Sem (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. II-Sem (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. I-Sem (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 SOFTWAREDEVELOPMENT 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*, 2nd Edition, Elsevier, 2014.
2. Kenneth J. Ayala, *The 8051 Microcontroller*, Thomson, 2nd 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
3. https://www.scribd.com/doc/55232437/Embedded-Systems-Raj-Kamal
4. https://docs.google.com/file/d/0B6Cytl4eS_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

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 electrect 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, 2nd 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*, 1st 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*, 3rd 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 Madisetti, *Cloud Computing – A Hands-on Approach,* Universities Press (India) Private Limited, 2014.
2. Greg Schulz, *Cloud and VirtualData StorageNetworking,* 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- : 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, 1st 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: ACourse 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*, 1st 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),* 1st 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

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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*", 1stedition, 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 andBig 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 **(9 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*, 1st 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
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),* 1st 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*, 3rd 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 Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
III B.Tech. I-Sem (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. II-Sem (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. I-Sem (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, 5th Edition, 2015.

REFERENCE BOOKS:

1. Behrouz A. Forouzan, *Data Communications and Networking*, McGraw Hill, 5th Edition, 2013.
2. James F. Kurose and Keith W. Ross, *Computer Networking: A Top-Down Approach*, Pearson, 7th 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:

CO2. Analyze performance of CPU scheduling algorithms.
CO3. Design solutions for process synchronization problems by using semaphores and monitors.
CO4. Devise solutions for deadlocks using deadlock handling mechanisms.
CO5. Solve memory management problems using page replacement and disk scheduling algorithms.
CO6. Identify efficient file allocation methods for optimal disk utilization.
CO7. 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, 9th Edition, 2016.

REFERENCE BOOKS:

1. William Stallings, *Operating Systems, Internals and Design Principles*, Pearson Education, 7th Edition, 2013.
2. Andrew S. Tanenbaum, *Modern Operating Systems*, PHI, 3rd 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.

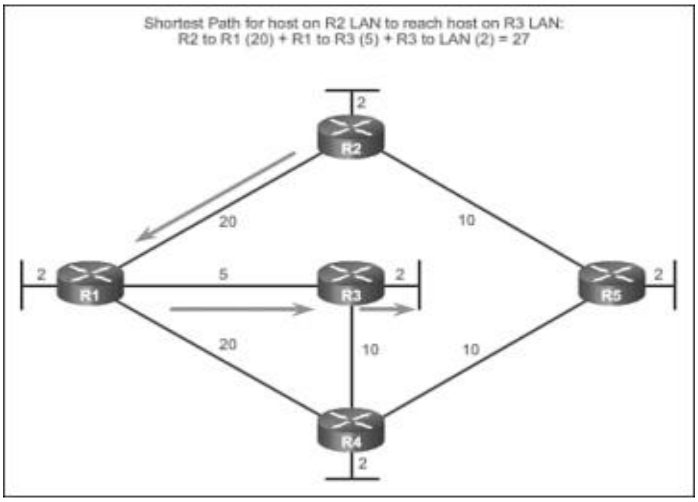
9. a) UDP uses a simple connectionless communication model with a minimum of protocol mechanism. The implementation provides checksums for data integrity, and port numbers for addressing different functions at the source and destination of the datagram. Simulate half duplex chat User Datagram Protocol.

   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, 5th 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)
- 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: UNDERSTANDINGCLOUD 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'Relly, 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 the course, 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

TEXTBOOKS:

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_Utilities
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 andweak 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, CYBERCRIMEIN 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, SunitBelapure, *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*, 1st Edition, Sybex, 2018.
3. ErdalOzkaya,*Cybersecurity: The Beginner's Guide*, 1st Edition,Packt Publishing, 2019.

ADDITIONAL LEARNING RESOURCES:

- Yuri Diogenes, ErdalOzkaya, *Cybersecurity: Attack and Defense Strategies*, 2nd 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, 7th Edition, 2017.
2. Douglas R. Stinson, *Cryptography: Theory and Practice*, CRC Press, 3rd 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_Utilities
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, 2nd Edition 2016.

REFERENCE BOOKS:

1. Security and Privacy in Internet of Things (IoTs): Models, Algorithms,and Implementations, Fei Hu, CRC Press2016.
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 Daniel 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)*", 4th Edition, Pearson Education 2011.
2. Andrew Lockhart "*Information security Hacks (Tips and Tools for protecting your privacy)*", 2nd 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/2014 1/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.	Ext.	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 TSL.

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.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			C	Scheme of Examination Max. Marks		
			L	T	P		Int. Marks	Ext. Marks	Total Marks
III B.Tech. I-Sem (2 Theory+ 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. II-Sem. (2 Theory+ 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. I-Sem. (1 Theory+ 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,5th edition, 2017.

REFERENCE BOOKS:

1. A. Anand Kumar, *Switching Theory and Logic Design*, PHI Learning Private Limited, 3rd edition, India, 2017.
2. Charles H. Roth, Jr. and Larry L. Kinney, *Fundamentals of Logic Design*, Cengage Learning, 7th 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^2L, 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 ω_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, 3rd Edition, 2003 .

REFERENCE BOOKS:

1. John F.Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4th Edition, 2008.
2. John M. Rabaey, *Digital Integrated Circuits: A Design Perspective*, PHI, 2nd 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. DevelopPrograms 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,* 3rd 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, 4th 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 - Virtual labs for digital circuits
2. https://nptel.ac.in/courses/108/108/108108031/
3. 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, 3rd 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
(19BT60409)**TESTING AND TESTABILITY**

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

PRE-REQUISITES: ACourse 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 Testto 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 Pulishers, 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, 1st Edition, 2001.
2. Alfred L. Crouch, "Design for Test for Digital ICs & Embedded Core Systems", Pearson Education, 1st Reprint Edition, 2007.
3. Robert J.Feugate, Jr., Steven M.Mclntyre, "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 systemlevels 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 8529;

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 2nd 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,* 3rd 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: Acourse 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 constrains)

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, 5th edition, 2004.
3. John F. Wakerly, Digital Design Principles & Practices, Pearson Education Asia, 4th Edition, 2008.
4. Stephen Brown and ZvonkoVramesic, Fundamentals of Digital Logic with VHDL Design, McGraw Hill, 2nd 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: ACourse 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, 1st Edition, 2008.
2. Santanu Chattopadyay, 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 POSSIX 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,1st 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 DESIGNAND 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, 3rd 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 SOCs: 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: ACourse 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, 1stEdition, 2008.
2. C P Ravikumar, *MSP430 Microcontrollers in Embedded System Projects*, Elite Publishing House , 1stEdition, 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 (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 (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 (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

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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, 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: BREAKDOWNPHENOMENA 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 o 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 MAINTENANC (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*", 2nd 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

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: Courses 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.

COURSEOUTCOMES: 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 ofwindenergy conversion technologies.

CO4. Understand the generating principles and operational aspects ofOcean energy, Biomass and geothermal energy conversion technologies.

CO5. Asses 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,1st 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: 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

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 student 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, 2nd edition, 2016.
2. Albert Thumann, William J. Younger, *Handbook of energy audits*, Taylor & Francis Ltd,7th edition, 2008.
3. UmeshRathore, *Energy management*, S.K. Kataria& Sons, 2nd edition, 2014.
4. W.C.Turner,Stevedoty, *Energy management hand boo*k, CRC press, 6th edition, 2006.
5. D.P. Sen, K.R. Padiyar, IndraneSen, 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), 1st 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
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.	Ext.	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*, clarenden press, Oxford, 1984.
2. T.J.E. Miller, *Brushless Permanent Magnet and Reluctance Motor Drives*, clarenden 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, 2ndedition, 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, student 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
4. https://www.youtube.com/watch?v=IkNIuFkzxBk
5. https://www.youtube.com/watch?v=730netBSZKY
6. 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*, 2nd edition, CRC Press, 2011.
2. Jack Erjavec, *Hybrid, Electric & Fuel-Cell Vehicles*, 2nd edition, Delmar Cengage learning, 2013.
3. MehrdadEhsani, Yimin Gao and Ali Emadi, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles*, 2nd 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
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: 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 variousprotection 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_6 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 lighting 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)*, 13th edition, Khanna Publishers, New Delhi, 2013.
2. Rohit Mehta and V.K. Mehta*Principles of Power System, 24thedition,* S. Chand Publishiing, 2010.

REFERENCE BOOKS:

1. Badri Ram, D. N. Viswakarma, *Power system Protection and Switchgear*, 2nd edition, McGraw Hill education (India) Private Limited, New Delhi, 2011.
2. C. L. Wadhwa, *Electrical Power systems*, 7th 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

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 INSTUMENTATION ENGINEERING

Students of Eligible Branches: CSE, CSSE, IT, ECE, EEE, ME and CE

COURSE STRUCTURE

Year &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+ 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. II-Sem (2 Theory+ 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. I-Sem (1 Theory+ 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, 19thRevised edition, 2013.
2. H S Kalsi, *Electronic Instrumentation and Measurements*, McGraw-Hill, 4th edition, 2019.

REFERENCE BOOKS:

1. E.W. Golding & F.C. Widdis, *Electrical Measurements and Measuring Instruments*, 5th edition, Wheeler Publishing.
2. Doeblin, E.O., Measurement Systems: Applications and Design, McGraw-Hill, 4th edition 2003.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105153/
2. 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 PallásAreny, 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
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 student will be able to

CO1. Demonstrate knowledge on discrete data systems, Z –Transform and modified Z - Transform of Sampled Data system.

CO2. Design of controllersbasedondiscretetimemodels areused in Industries.

CO3. Analyze various control strategies and identify mathematical model for various systems.

CO4. Asses 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: SYSTEMIDENTIFICATION (08 Periods)

SystemTheory,Mathematicalmodels,Modelproperties,Structuralmodelrepresentation,Systemidentificationprocedure. Modified Z – Transform, First order system with timedelay.

UNIT-III: DESIGNOF CONTROLLERS (09 Periods)

Computer control loop, Convertingcontinuoustimecontrollertodiscretetimedomain, DesignofcontrollersbasedondiscretetimemodelbeatandDahlin'salgorithms.DesignofFeedForwardController:BlockDiagram.

UNIT-IV: ADVANCED PROCESS CONTROLSTRATEGIES (09 Periods)

Cascade Control- Dynamic response, Types, Implementation, Predictive Control–ModelbasedandMultivariableSystem,StatisticalProcessControl.
AlgorithmsforProcesseswithDeadTime–SmithPredictor,Analytical Predictor.

UNIT-V: ADAPTIVECONTROL **(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 ofAmerica,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
4. 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 the course, 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)

14. 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.

15. Data Acquisition and analysis using Graphs, Charts, myRio/ELVIS and LabVIEW.
16. Data Logging and analysis of simulated or acquired signals using File I/O.
17. Design and verification of converters using op-amps in Multisim.

a) I to V

b) V to I

18. Design and verification of resistance measurement, conversion in Multsim using

a) Op-Amp

b) Wheatstone bridge for improving sensitivity, compensation and linearity.

19. Measurement of Pressure.

20. Measurement of Humidity.
21. Measurement of Flow.
22. Measurement of Torque.
23. Measurement of Viscosity.
24. Design and verification of level measurement.
25. Design and verification of Speed measurement.
26. 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, 4th 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 Wileyand 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:

5. NI Labview 2018
6. NI Circuit Design Suite – Multisim 2019
7. NI myRIO
8. NI ELVIS

ADDITIONAL LEARNING RESOURCES:

7. https://www.ni.com/pdf/manuals/320999e.pdf
8. https://ieeexplore.ieee.org/document/8960023/
   A Different way of Level measurement for PBL in Education of Students using NI-LabVIEW, Multisim and MyRIO
9. http://www.ni.com/pdf/manuals/376047c.pdf
10. https://www.clemson.edu/cecas/departments/ece/document_resource/undergrad/lab_manuals/NI_ELIVS_II_Orientation_Manual.pdf
11. http://www.ni.com/pdf/manuals/374629c.pdf
12. 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 andSystems*, I K International Publishing House Pvt. Ltd,2010

REFERENCE BOOK:

1. Pallett, E.H.J, *AircraftInstruments 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

IIIB. 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 responsemethod.

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 reflex rate, constant reflex 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, 7thEdition, 2002.
3. G. Stephanopoulis, *Chemical Process Control,* PrenticeHall, 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, 2nd 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.

TotalPeriods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOKS:

1. Nikolay Kirianaki, Sergey Yurish, Nestor Shpak, Vadim Deynega , "*Data Acquisition and Signal Processing for Smart Sensors*", John Wiley & Sons Ltd, 1st edition, 2002.
2. Jacob Fraden , "*Handbook of Modern Sensors: Physics, Designs, And Applications*", Springer, 5th edition, 2016.
3. Randy Frank, "*Understanding Smart Sensors*", Artech House, 3rd Edition, 2013.

REFERENCE BOOKS:

1. Sergio Franco*, "Design with Operational Amplifiers and Analog Integrated Circuits",* McGraw-Hill Education, 4th 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., 1st edition, 2012.

ADDITIONAL LEARNING RESOURCES:

1. **Smart sensors:**

   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

2. **MEMS Technologies: Photolithography**

   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 completion of this course, the student 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. DonaldP.Eckman,*AutomaticProcessControl*,WileyEasternLtd., 1993.
2. Curtis D. Johnson, *Process Control Instrumentation Technology*, Pearson Education, New Delhi, 7th Edition, 2002.

ADDITIONAL LEARNING RESOURCES:

1. 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

IVB. 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 theraptic 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, Pnemuotachograph 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, Comparision between internal & external Pacemakers; Defibrillators: AC Defibrillator, DC Defibrillator, Synchronised DC Defibrillator; Diathermy: Shortwave and microwave, Dialysis: Hemo Dialysis, Peritonal 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.

TotalPeriods: 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*", 3rd 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
3. https://nptel.ac.in

IVB. 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 usingcontacts 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, OutputRegisters.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, Matrixfunctions.

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*, 5thedition, PHI 2009.

REFERENCE BOOKS:

1. Frank D. Petruzella,*Programmable Logic Controller*, 3rd edition, Tata Mc-Graw Hill, 2010.
2. M.Chidambaram, *Computer Control of Process*, Narosa 2003.

ADDITIONAL LEARNING RESOURCES

1. https//openautomationsoftware.com/use cases /allenbradleywpfscada/
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: A Course on Biomedical Instrumentation.

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 the course, 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*", 3rd 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. I-Sem (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. II-Sem (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. I-Sem (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 therespective 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: -

COURSEDESCRIPTION: 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, 4th Edition, 2018.
2. M. Groover, *CAD/CAM*, Pearson Education; 1st 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. Yorem 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 controlsfor 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. Second Edition, 2012.
4. Khushdeep goyal, Deepak Bhandari*, Industrial automation and robotics*, Katson books, 2013.

REFERENCE BOOKS:

1. Hibbeller 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: -

COURSEDESCRIPTION: 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, 4th Edition, 2013.
2. Frank. D.Petruzella*, Programmable Logic Controllers,* Tata McGraw-Hill Education, 4thEdition, 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 Langrangian 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 student 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^{th} 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*, ElsevierLtd,2015.
2. Aleksandar Lazinica, -*MobileRobotsTowards NewApplications*, Advanced Robotic SystemsInternational, 2006.
3. LMarques,AdeAlmeida,Mo Tokhi,GSVirk, -*Advancesin MobileRobotics*, World Scientific PublishingCo. Pte.Ltd. 2008.
4. Bruno Siciliano, OussamaKhatib, -*Springer Handbook of Robotics*, Springer-Verlag BerlinHeidelberg,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 pendent 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: FUNDAMEMNTALS OF ROBOT PROGRAMMING (09 Periods)

Robot software functions - coordinate systems, Position control, Oher 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^{nd} 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^{rd} 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: Vison systems; Components of vision systems; Elements of visual perception; Low level vison; Filters; Higher level visions; 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 LEVELVISION: (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 Intelligence‖,* 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* ,2nd 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, 2nd 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 (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 (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 (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 therespective 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, 1st Edition, 2012.

REFERENCE BOOKS:

1. Bradley. A. S; Adebayo, A. O., Maria, P., *Engineering Applications in Sustainable Design and Developmen*t, Cengage Learning, 1st Edition, 2016.
2. Purohit, S. S., *Green Technology: An Approach for Sustainable Environment*, Agrobios Publication, 1st 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, 3rd Edition, 2015.

ADDITIONAL LEARNING RESOURCES:

1. Daniel A. Vallero and Chris Brasier, *Sustainable Design: The Science of Sustainability and Green Engineering*, Wiley-Blackwell, 1st 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, 1st 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: 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 environmentalproblems using appropriate tools and techniques considering society, health, environment and sustainability besides communicatingeffectivelyingraphicalform.

CO2. Analyze the ecosystems to solve environmentalproblems using appropriate tools and techniques considering society, health, safety, environment and sustainability besides communicatingeffectivelyingraphicalform.

CO3. Analyze the ecological impact assessment to solvecomplex environmental problems using appropriate tools and techniques following relevant standards and norms considering society, health, safety, environment, sustainability and economics besides communicatingeffectivelyingraphicalform.

CO4. Analyze the eco-toxicology effects and bio-monitoring of ecosystems to solvecomplex environmental problems using appropriate tools and techniques following relevant standards and norms considering society, health, safety, environment, sustainability and project management besides communicatingeffectivelyingraphicalform.

CO5. Analyze ecology of disturbed ecosystems, reconstructions and restoration of natural ecosystems to solve complexenvironmentalproblems following relevant standards and latest developments considering society, health, safety, environment, sustainability and project management besides communicatingeffectivelyingraphicalform.

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, 1st Edition, 2010.
2. Walker, C. H., Hopkin, S. P., Sibly R. M. and Peakall, D. B., *Principles of Ecotoxicology*, Taylor and Francis Group, London, 2nd 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, 3rd Edition, 2001.
2. Smith, T. M. and Smith, R. L., *Elements of Ecology*, Pearson Education Ltd., England, 9th 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, 2nd Edition, 2019.
2. Charles J. Krebs, *Ecology: The Experimental Analysis of Distribution and Abundance*, Pearson Education India, 6th Edition, 2008.
3. Mani, M., Ganesh, L.S. and Varghese, K., *Sustainability and Human Settlements*, Sage Publications, New Delhi, 1st 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 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 prospective, 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, 1st Edition, 2017.
2. Singh, R. P., Prasad, V. and Vaish, B., *Advances in Waste-to-Energy Technologies*, CRC Press, 1st Edition, 2019.

REFERENCE BOOKS:

1. Maczulak, A. E., *Environmental Engineering: Designing a Sustainable Future,* Infobase Publishing, 4th Edition, 2010.
2. Kalogirou, E. N., *Waste-to-Energy Technologies and Global Applications*, CRC Press, 1st Edition, 2017.
3. Klinghoffer, N. B., & Castaldi, M. J., *Waste to Energy Conversion Technology*, Elsevier, 3rd Edition, 2013.

ADDITIONAL LEARNING RESOURCES:

1. Rogoff, M. J., & Screve, F., *Waste-to-energy: Technologies and Project Implementation*, Academic Press, 1st Edition, 2019.
2. Trabold, T., and Babbitt, C. W., *Sustainable Food Waste-to-Energy Systems*, Academic Press, 1st Edition, 2018.

III B. Tech. - II Semester
(19BT60126) **ENVIRONMENTAL SUSTAINABILITY**

Int. Marks	Ext. Marks	Total Marks	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 overshot 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, 5th 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, 2nd Edition, 2017.
2. Joumard, Robert, and Henrik Gudmundsson, *Indicators of Environmental Sustainability in Transport: An Interdisciplinary Approach to Methods,* European Commission, 2nd Edition, *2010.*
3. Smith, Fraser, *Environmental Sustainability: Practical Global Applications*, CRC Press, 1st Edition, 2020.

ADDITIONAL LEARNING RESOURCES:

1. Burke, G., Singh,B. R. and Theodore, L., *Handbook of Environmental Management and Technology*, John Wiley & Sons, 2nd Edition, 2000.
2. Peavy, Howard S., Donald R. Rowe, and George Tchobanoglous, *Environmental Engineering*, McGraw-Hill, Indian Edition, 1st 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, 3rd 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, 2nd Edition, 2012.

REFERENCE BOOKS:

1. Gilbert M. Masters, *Renewable and Efficient Electric Power Systems*, John Wiley &Sons, Inc., Hoboken, New Jersey, 2nd Edition, 2013.
2. Vanek, F.M., Albright, L.D., *Energy Systems Engineering - Evaluation and Implementation*, McGraw-Hill, 2nd 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, 2nd Edition, 2014.

ADDITIONAL LEARNING RESOURCES:

1. Richter Burton, *Beyond Smoke and Mirrors: Climate Change and Energy in the 21st 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 onEnvironmental 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; CO2 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 CO2, 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, 1st Edition, 2012.
2. Kevin Lynch and Gary Hack, *Site Planning*, MIT Press, 3rd Edition, 1984.

REFERENCE BOOKS:

1. William McLean and Pete Silver, *Environmental Design Source Book: Innovative Ideas for a Sustainable Built Environment*, RIBA Publishing, 1st 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, 1st Edition, 2019.
4. Charles J. Kibert, *Sustainable Construction: Green Building Design and Delivery,* Wiley,4th Edition, 2021.

ADDITIONAL LEARNING RESOURCES:

1. Mani, M., Ganesh, L.S. and Varghese, K., *Sustainability and Human Settlements,* Sage Publications, 1st Edition, 2005.
2. Barton, H., Grant, M., Guise, R., *Shaping Neighbourhoods: For Local Health and Global Sustainability*, Routledge Press, 2nd 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 Marks	L	T	P	C
40	60	100	3	-	–	3

PREREQUISITES: Courses onEnvironmental 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, 9th 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, 2nd Edition, 2006.
2. Tietenberg, Tom and Lynne Lewis, *Environmental and Natural Resource Economics*, Routledge, 11th 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, 8th 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 onEnvironmental 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 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, 1st 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, 2nd Edition, 2012.
2. Corburn, J., *Toward the Healthy City: People, Places and the Politics of Urban Planning,* MIT Press, 3rd 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 onEnvironmental 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 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 guidelinesto 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, 1st 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, 1st Edition, 2017.
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ADDITIONAL LEARNING RESOURCES:

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