ACADEMIC REGULATIONS

COURSE STRUCTURE

AND

DETAILED SYLLABI

OF

ELECTRICAL AND ELECTRONICS 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 ELECTRICAL AND ELECTRONICS ENGINEERING

VISION

To become the Nation's premiere centre of excellence in electrical engineering through teaching, training, research and innovation to create competent engineering professionals with values and ethics.

MISSION

- Imparting Knowledge through implementing modern curriculum, academic flexibility and learner centric teaching methods in Electrical Engineering.
- Inspiring students for aptitude to research and innovation by exposing them to industry and societal needs to creating solutions for contemporary problems.
- Honing technical and soft skills for enhanced learning outcomes and employability of students with diverse background through comprehensive training methodologies.
- Inculcate values and ethics among students for a holistic engineering professional practice.

PROGRAM EDUCATIONAL OBJECTIVES

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

1. Enrolled in academic program in the disciplines of electrical engineering, multidisciplinary areas and management studies.
2. Become entrepreneurs or be employed as productive and valued engineers in reputed industries.
3. Engage in lifelong learning, career enhancement and adopt to changing professional and societal needs.

PROGRAM OUTCOMES

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

PSO1: **Plan** to **conserve and harness** electrical energy using electrical and electronic systems for **sustainability**.

PSO2: Use domain specific **tools** to **analyze, design and develop** electrical and electronic systems for feasible operation and control of Electrical and Electronic Systems.

PSO3: Develop **operating strategies** for utilization of energy and **application** of Electrical and Electronics systems in relevance to industry and society.

SREE VIDYANIKETHAN ENGINEERING COLLEGE (AUTONOMOUS)

(Affiliated to J.N.T. University Anantapur, Ananthapuramu)

ACADEMIC REGULATIONS (SVEC-19)

CHOICE BASED CREDIT SYSTEM

B.Tech. Regular Four Year Degree Program

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

and

B.Tech. (Lateral Entry Scheme)

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

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

1. Applicability:

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

2. Extent:

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

3. Admission:

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

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

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

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

(a) By the Convener, EAMCET, (for Category-A Seats).

(b) By the Management (for Category-B Seats).

(c) By the Management (for 15% Supernumerary Quota) for Persons of Indian Origin (PIO)/Foreign Nationals (FN)/ Children of Indian Workers in Gulf Countries/ Overseas Citizen of India (OCI)

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

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

(i) Passed Diploma in Engineering in the relevant branch conducted by the Board of Technical Education, Andhra Pradesh (or equivalent Diploma recognized by JNTUA, Ananthapuramu).

(ii) Candidates qualified in ECET and admitted by the Convener, ECET. In all such cases for admission, when needed, permissions from the statutory bodies are to be obtained.

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

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

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

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

5. Duration of the Program:

5.1 **Minimum Duration:** The program shall extend over a period of four years leading to the Degree of Bachelor of Technology (B.Tech) of the JNTUA, Ananthapuramu. The four academic years shall be divided into eight semesters with two semesters per year. Each semester shall normally consist of 21 weeks (Minimum of 90 working days) having - Continuous Internal Evaluation (CIE) and Semester End Examination (SEE), Choice Based Credit System (CBCS) and Credit Based Semester System(CBSS) as suggested by UGC and Curriculum/ Course Structure as suggested by AICTE are followed. Provision is made for lateral entry admission of students into the Second Year of the program in all the branches of study and they shall be required to satisfy the conditions of admissions thereto prescribed by the JNTUA, Ananthapuramu and Government of Andhra Pradesh.

5.2 Maximum Duration:

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

6. Structure of the Program:

Each Program of study shall consist of:

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

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

Contact Periods:

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

7. Credit Courses:

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

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

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

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

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

8. Choice Based Credit System (CBCS):

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

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

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

9. Course Enrollment and Registration

9.1 Each student, on admission shall be assigned to a Faculty Advisor (Mentor) who shall advice and counsel the student about the details of the academic program and the choice of courses considering the student's academic background and career objectives.

9.2 Each student on admission shall register for all the courses prescribed in the curriculum in the student's first and second Semesters of study. The student shall enroll for the courses with the help of the student's Faculty Advisor (Mentor). The enrollment for the courses from II B.Tech I Semester to IV B.Tech I Semester shall commence 10 days prior to the last instructional day of the preceding semester for registration process. If the student wishes, the student may drop or add courses (vide clause 8) 10 days prior to commencement of the concerned semester and complete the registration process duly authorized by the Chairman, Board of Studies of concerned department.

9.3 If any student fails to register the courses in a semester, he shall undergo the courses as per the program structure.

9.4 After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment marks and appear for the Semester-end Examinations.

9.5 Elective courses shall be offered by a Department only if a minimum of 40 students register for that course.

10. OPEN ELECTIVE (MOOC)

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

10.1 A Student is offered an Open Elective (MOOC), in the IV B.Tech I-Semester, and is pursued through Massive Open Online Course (MOOC) platforms. The duration of the MOOC courses shall be for a minimum period of 08 weeks.

10.2 The student shall confirm registration by enrolling the course within 10 days prior to the last instructional day of the III B.Tech II-Semester along with other courses.

10.3 The list of courses along with MOOC service providers shall be identified by the Chairman, BOS, and Head of the Department. The identified Open Elective (MOOC) courses are to be approved by the Chairman, Academic Council.

10.4 The student has to submit MOOC certificate with percentage of Score earned to the Head of the Department at the end of the semester. Based on the score earned, the equivalent Grade Point and Credits will be assigned.

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

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

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

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

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

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

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

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

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

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

12. Examination System:

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

<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 rowspan="3">2.</td><td rowspan="3">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>
<tr><td rowspan="2">50</td><td>30</td><td>Day-to-Day evaluation for Performance in laboratory experiments and Record.
(Internal evaluation).</td><td rowspan="2">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.</td></tr>
<tr><td>20</td><td>Practical test
(Internal evaluation).</td></tr>
</table>

Sl. No.	Course	Marks	Examination and Evaluation		Scheme of examination
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	-		The student has to submit MOOC certificate with percentage of Score earned to the Head of the Department at the end of the semester. Based on the score the equivalent Grade Point and Credits will be assigned as given in 10.4.
5.	Socially Relevant Project	100	50	Internal Evaluation	Shall be evaluated as given in 12.2.2(i)
			50	Semester-end evaluation	Viva-Voce examination shall be conducted at the end of the semester as given in 12.2.2(ii)
6.	Mandatory Courses	40	Internal Evaluation		Shall be evaluated as given in 12.2.4
7.	Audit Courses	-	-		As detailed in 12.2.5
8.	Project Work	200	100	Internal evaluation	Continuous evaluation shall be done by the Project Evaluation Committee (**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 Minor degree 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 or after the examination.	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.
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 (EEE) Program

(Effective from the Academic year 2019-20 onwards)

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
ELECTRICAL AND ELECTRONICS ENGINEERING
I B.Tech.– ISemester

Sl. No.	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
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
			14	**1**	**6**	**21**	**18**	**35**	**450**	**800**
9.	19BT1AC01	Spoken English	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**

I B.Tech.-IISemester

Sl. No.	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
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.	19BT20201	Electric Circuits	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.	19BT20231	Electric Circuits Lab	-	-	2	2	1	50	50	100
		Total:	**15**	**4**	**10**	**29**	**24**	**450**	**550**	**1000**

II B.Tech.–ISemester

Sl. No.	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
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.	19BT30201	Electrical Machines-I	3	1	-	4	4	40	60	100
4.	19BT30202	Electromagnetic Fields	3	-	-	3	3	40	60	100
5.	19BT30203	Signals and Networks	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.	19BT30231	Electrical Machines-I Lab	-	-	2	2	1	50	50	100
9.	19BT30232	Signals and Networks 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.	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
1.	19BT40441	Analog Electronics	3	-	-	3	3	40	60	100
2.	19BT40201	Digital Electronics	3	-	-	3	3	40	60	100
3.	19BT40202	Electrical Machines-II	3	1	-	4	4	40	60	100
4.	19BT40203	Electrical Measurements	3	-	-	3	3	40	60	100
5.	19BT40204	Transmission and Distribution	3	-	-	3	3	40	60	100
6.	**Open Elective-1**		3	-	-	3	3	40	60	100
7.	19BT40231	Digital Electronics Lab	-	-	2	2	1	50	50	100
8.	19BT40232	Electrical Engineering Workshop	-	-	2	2	1	50	50	100
9.	19BT40233	Electrical Machines-II 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

Sl. No.	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
1.	19BT40403	Linear and Digital IC Applications	3	-	-	3	3	40	60	100
2.	19BT50201	Control Systems	3	-	-	3	3	40	60	100
3.	19BT50202	Power System Operation and Control	3	-	-	3	3	40	60	100
4.	**Professional Elective–1**		3	-	-	3	3	40	60	100
	19BT50203	Electrical Machine Design								
	19BT50204	Energy Systems								
	19BT50205	Energy Audit, Conservation and Management								
	19BT50206	Instrumentation								
5.	**Open Elective-2**		3	-	-	3	3	40	60	100
6.	**Inter Disciplinary Elective-1**		3	-	-	3	3	40	60	100
	19BT50442	Principles of Communications								
	19BT51041	PLC and SCADA								
	19BT51042	Sensors and Signal Conditioning								
	19BT50207	Computer Organization and Architecture								
7.	19BT61531	Internet of Things Lab	-	1	2	3	2	50	50	100
8.	19BT40433	Linear and Digital IC Applications Lab	-	-	2	2	1	50	50	100
9.	19BT50231	Socially Relevant Project-I	-	-	-	-	1	50	50	100
		Total:	**18**	**1**	**4**	**23**	**22**	**390**	**510**	**900**
10.	19BT503AC	Foundations of Entrepreneurship	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**

III B.Tech.– II Semester

Sl. No.	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
1.	19BT6HS01	Principles of Business Economics and Accountancy	3	-	-	3	3	40	60	100
2.	19BT60201	Power Electronics	3	-	-	3	3	40	60	100
3.	19BT60202	Power System Analysis	3	-	-	3	3	40	60	100
4.	**Professional Elective-2**		3	-	-	3	3	40	60	100
	19BT60203	Advanced Control Systems								
	19BT60204	High Voltage Engineering								
	19BT60205	Special Electrical Machines								
	19BT60206	PIC Microcontrollers								
5.	**Professional Elective-3**		3	-	-	3	3	40	60	100
	19BT50403	VLSI Design								
	19BT60207	Design and Estimation of Electrical Systems								
	19BT60208	Distributed Generation and Microgrid								
	19BT60209	Power System Automation								
6.	**Inter Disciplinary Elective-2**		3	-	-	3	3	40	60	100
	19BT50406	FPGA Architectures and Applications								
	19BT60407	Image Processing								
	19BT50408	Microelectromechanical Systems								
	19BT61003	Industrial Data Communication								
7.	19BT60231	Electrical CAD Lab	-	-	2	2	1	50	50	100
8.	19BT60232	Electrical Power Systems Lab	-	-	2	2	1	50	50	100
9.	19BT60233	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

Sl. No.	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
1.	19BT6HS02	Organizational Behavior	3	-	-	3	3	40	60	100
2.	19BT70201	Solid State Drives	3	-	-	3	3	40	60	100
3.	19BT70202	Switchgear and Protection	3	-	-	3	3	40	60	100
4.	**Professional Elective–4**		3	-	-	3	3	40	60	100
	19BT70401	Embedded Systems								
	19BT70203	Analysis of Power Electronic Converters								
	19BT70204	Electric Vehicles								
	19BT70205	Flexible AC Transmission System								
5.	**Professional Elective–5**		3	-	-	3	3	40	60	100
	19BT70206	Digital Signal Processing for Electrical Engineering								
	19BT70207	Soft Computing Techniques								
	19BT70208	Smart Grid Technology								
	19BT70209	Power Electronics for Renewable Energy Systems								
6.	19BT7MOOC	MOOC	-	-	-	-	3	-	100	100
7.	19BT70231	Power Electronics and Drives Lab	-	-	2	2	1	50	50	100
8.	19BT70232	Power System Simulation Lab	-	-	2	2	1	50	50	100
9.	19BT70233	Internship	-	-	-	-	2	--	100	100
		Total:	**15**	**0**	**4**	**19**	**22**	**300**	**600**	**900**
10.	19BT702AC	Electrical Safety and Safety Management	**2**	**-**	**-**	**2**	**-**	**-**	**-**	**-**

** Student shall undertake the Industrial Training/Internship/Research Projects in National Laboratories/Academic Institutions for a minimum period of 4 weeks.*

IV B.Tech.– II Semester

Sl. No.	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
1.	19BT80231	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 ELECTRICAL AND ELECTRONICS ENGINEERING

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-I	19BT50208	Dynamics of Electrical Machines	3	-	-	3	3	40	60	100
	19BT50209	Machine Learning for Electrical Engineering	3	-	-	3	3	40	60	100
	19BT50210	Reactive Power Compensation and Management	3	-	-	3	3	40	60	100
III-II	19BT60210	Controllers for Power Applications	3	-	-	3	3	40	60	100
	19BT60211	Power Semiconductor Devices and Modeling	3	-	-	3	3	40	60	100
	19BT60212	Power System Reliability	3	-	-	3	3	40	60	100
IV-I	19BT70210	Digital Control of Power Electronic and Drive Systems	3	-	-	3	3	40	60	100
	19BT70211	Power System Deregulation	3	-	-	3	3	40	60	100
	19BT70212	Power System Security and State Estimation	3	-	-	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 CE, ME, EEE, ECE, EIE, CSE, CSSE and IT)

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

PRE-REQUISITES: -

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

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

CO1. Formulate and solve differential equations by applying knowledge of calculus for engineering problems.

CO2. Demonstrate knowledge in multivariable calculus for evaluating multiple integrals through techniques of integration.

CO3. Identify scalar and vector valued functions and evaluate vector integrals through knowledge of vector integral theorems and techniques.

DETAILED SYLLABUS:

UNIT-I: ORDINARY DIFFERENTIAL EQUATIONS (9 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 (9 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) (9 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) (9 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) (9 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)- Applications.

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 EEE, ECE and EIE)

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

PRE-REQUISITES: -

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

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

CO1. Apply the basic knowledge of biology to understand the significance of various biological techniques.

CO2. Identify the role of DNA in the molecular basis of information transfer and understand single gene disorders related to the health perspective.

CO3. Apply the basic knowledge of bio-analytical devices and methods to assess health issues.

DETAILED SYLLABUS:

UNIT-I: LIVING ORGANISMS (6 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 (6 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 (6 Periods)

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

UNIT-IV: RECOMBINANT DNA TECHNOLOGY (6 Periods)

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

UNIT-V: HUMAN PHYSIOLOGY AND APPLIED BIOLOGY (6 Periods)

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

Total Periods: 30

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

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

REFERENCE BOOKS:

1. B. Alberts, A. Johnson et al., *The molecular biology of the cell*, Garland Science, 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 EEE, ECE and EIE)

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

PRE-REQUISITES: -

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

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

CO1. Apply the knowledge of light waves to interpret the concepts of Interference, Diffraction and Polarization.
CO2. Demonstrate the concepts of electromagnetic wave propagation in 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 (9 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 (9 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 (7 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, 2ndEdition, 2009.

REFERENCE BOOKS:

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

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

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

PRE-REQUISITES: -

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

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

CO1. apply the basic principles of civil engineering, Techniques and tools for analyzing civil structures and solve related problems.

CO2. describe the working of principles of basic mechanical engineering and solve problems related to it.

DETAILED SYLLABUS:

Part – A: CIVIL ENGINEERING

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

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

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

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

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

UNIT–II: BUILDING COMPONENTS AND CIVIL ENGINEERING INFRASTRUCTURE (8 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 **(9 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 **(9 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 **(9 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 MS, *Basic Civil and Mechanical Engineering*, Tata McGraw Hill PublishingCo.,NewDelhi, 1stEdition 2018.
2. R. Vaishnavi, Prof. M. Prabhakaran & Prof. V. Vijayan, *Basic Civil and Mechanical Engineering*, S.CHAND Publications, 2ndEdition, 2013.
3. B.C Punmia, Ashok Kumar Jain, Arun kumar Jain, *Surveying (vol-I),* Laxmi publications, 16th Edition, 2005.
4. B.C Punmia, Ashok Kumar Jain, Arun kumar Jain, *Building Construction,* Laxmi publications, 10th Edition, 2008.

REFERENCES BOOKS:

1. Seetharaman S., *Basic Civil Engineering*, Anuradha Agencies, 2005.
2. Ramamrutham S., *Basic Civil Engineering*, Dhanpat Rai Publishing Co.(P) Ltd.1999.
3. Kalpakjian, Serope, *Manufacturing Engineering and Technology,* Pearson Education, 7thEdition, 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 (9 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 (9 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 (9 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 **(8 Periods)**

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

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Ashfaq Hussain*, Fundamentals of Electrical Engineering,* Dhanpatrai & Co. (P) Ltd., *3rd* Edition, New Delhi, 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 EEE, ECE and EIE)

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

PRE - REQUISITES: -

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

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

CO1. Apply the basic knowledge of light waves and semiconductors to demonstrate the functioning of optoelectronic devices.

CO2. Understand the experimental procedures to calculate the thickness of a thin film, Hall coefficient, Hysteresis losses, and acceptance angle of an optical fiber.

CO3. Determine the experimental values of magnetic field induction, wave length of a light source, energy gap of a semiconductor.

CO4. Apply skills to plot characteristic curves to determine the various parameters of semiconductor diodes.

CO5. Work independently and in teams to solve problems with effective communication.

List of Engineering Physics Experiments: A minimum of any **Ten** experiments are to be conducted among the following:

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

REFERENCES:

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

I B. Tech. – I Semester

(19BT10231) BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

(Common to EEE, ECE and EIE)

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

PRE-REQUISITES: A course on 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. Yannis Tsividis, *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 EEE, ECE and EIE)

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

PRE-REQUISITES: -

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

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

CO1. design and model various basic prototypes in the trade of fitting such as square/half round mating, V-mating and dovetail mating from the given MS work pieces using fitting tools.

CO2. develop different prototypes in the carpentry trade such as cross lap joint, dovetail / bridle joints and Mortise and Tenon joint using carpentry tools.

CO3. design and model different prototypes in the sheet metal forming trade such as rectangular tray, square vessel/cylinder, Funnel as per the dimensions using sheet metal forming tools.

CO4. develop sand mold using single piece pattern and split piece pattern in the foundry trade using foundry tools.

CO5. demonstrate the knowledge on automobile parts, power tools, plumbing operation, 3D printing technology involved in different engineering applications.

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

DETAILED SYLLABUS:

Student shall perform any **Twelve Exercises**

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:

1. Prepare a cross lap joint
2. Prepare dovetail / bridle joints

3. 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:

1. Fabricate a rectangular tray as per the dimensions
2. Fabricate square vessel/cylinder as per the dimensions
3. 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:

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

DEMONSTRATION:

1. Demonstrate the dismantling and assembling of various two wheeler parts
2. Demonstrate the usage of power tools.
3. Demonstrate the plumbing operation and identify the essential tool and materials required for plumbing.
4. Demonstrate the working of 3D printer

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**

(Audit Course)

(Common to EEE, ECE and EIE)

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

PRE-REQUISITES: -

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

CO1. Demonstrate knowledge of grammar and vocabulary in writing effective formal letters and e-mails.

CO2. Communicate effectively by applying appropriate speaking and writing techniques by examining and applying functional English.

DETAILED SYLLABUS:

UNIT-I: FUNCTIONAL ENGLISH (6 Periods)

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

UNIT-II: VOCABULARY BUILDING (6 Periods)

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

UNIT-III: FUNCTIONAL GRAMMAR - I (6 Periods)

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

UNIT-IV: FUNCTIONAL GRAMMAR – II (6 periods)

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

UNIT-V: COMMUNICATION SKILLS (6 Periods)

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

Total Periods: 30

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

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

REFERENCE BOOKS:

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

ADDITIONAL LEARNING RESOURCES:

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

I B. Tech. - II semester

(19BT2BS01) TRANSFORMATION TECHNIQUES AND LINEAR ALGEBRA

(Common to 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 (9 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 (9 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 (9 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) (9 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) (9 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 EEE, ECE and EIE)

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

PRE-REQUISITES: -

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

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

CO1. Apply the basic knowledge of quantum mechanical approach to atomic structure and bonding theories to identify shapes of different orbitals and molecules.

CO2. Analyze and solve problems associated with hardness of water, boiler troubles and address the societal, health and safety issues related to quality of water.

CO3. Apply the basic knowledge of corrosion phenomenon to identify solutions for control of corrosion and demonstrate competency in the basic concepts of electrochemical cells.

CO4. Demonstrate the basic knowledge of instrumental methods and their applications in the structural analysis of materials.

CO5. Apply the basic knowledge of fuel chemistry and lubricants to identify the quality of fuels and lubricants.

DETAILED SYLLABUS:

UNIT-I: ATOMIC STRUCTURE AND BONDING THEORIES (9 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 (9 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, de fluoridation method – Nalgonda method; merits and demerits of various de fluoridation 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 (9 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 (8 Periods)

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

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

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. P. C. Jain & Monika Jain*, Engineering Chemistry*, Dhanpat Rai Publishing Company (P) Ltd, New Delhi, 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 EEE, ECE and EIE)

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

PRE-REQUISITES: -

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

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

CO1. Demonstrate knowledge of English language by examining and applying the aspects of Process of communication, Paralinguistic features, Skimming, Scanning, and Elements of style in writing.

CO2. Analyze the modes and techniques of listening, speaking, reading, writing and apply appropriately to communicate effectively with the engineering community and society.

CO3. Apply reading and writing techniques in preparing documents by examining SQ3R Technique, Writer's Block, and Précis Writing.

CO4. Communicate effectively applying appropriate speaking techniques by examining and applying the communication styles in Conferences, Symposia, Seminars and Persuasive Speaking.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO COMMUNICATION (9 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 (9 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 (9 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 (9 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 **(9 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 & Pushp Lata, *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 EEE, ECE and EIE)

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

PRE-REQUISITES: A course on Basic Mathematics.

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

COURSE OUTCOMES: After successful completion of this course, the students will be able to:
CO1. Demonstrate knowledge on Python constructs to solve basic problems.
CO2. 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 (8 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 (9 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 (8 Periods)
Pandas: creating data frame, reading data from CSV files, indexing and selecting data, dealing with rows and columns; Visualization - bar plots, histogram, Scatter Plot.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. R. Nageswara Rao, *Core Python Programming,* 2nd Edition, Dreamtech Press, 2018.
2. R. G. Dromey, *How to solve it by Computer,* Pearson, 2006.

REFERENCE BOOKS:

1. Reema Thareja, *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

(19BT20201) **ELECTRIC CIRCUITS**

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

PRE-REQUISITES: A course on Physics at Intermediate Level.

COURSE DESCRIPTION: Circuit reduction and analyzing techniques; Analysis of single and poly phase circuits; Circuit theorems; Magnetically coupled circuits and Two-Port networks.

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

CO1. analyze the electrical circuits by applying the principles of network reduction techniques, mesh and nodal analysis.

CO2. analyze the single and poly phase circuits to investigate the response and to determine various electrical quantities.

CO3. analyze various electrical circuits, by applying circuit theorems to determine the response for AC and DC excitations.

CO4. analyze coupled circuits by applying the principles of electromagnetism and determine various parameters.

CO5. design an appropriate filter network for the given specifications.

DETAILED SYLLABUS:

UNIT-I: FUNDAMENTALS OF ELECTRIC CIRCUITS (9 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 AND THREE PHASE AC CIRCUITS (12 Periods)

Peak factor and form factor for different wave forms; Analysis of single phase AC circuits: impedance and admittance, impedance triangle; Power triangle; Sinusoidal response of R, L and C elements with different combinations; Resonance, bandwidth and quality factor for series and parallel networks.

Analysis of three phase balanced and unbalanced systems; Measurement of active and reactive power in balanced and unbalanced systems-single wattmeter and two wattmeter methods.

UNIT-III: CIRCUIT THEOREMS (10 Periods)

Superposition, Thevenin’s, Norton’s, Maximum power transfer, Millmann’s, Telligen’s, Compensation and Reciprocity theorems for DC & AC Excitations (without proof); Concept of dual and duality.

UNIT-IV: MAGNETICALLY COUPLED CIRCUITS **(6 Periods)**
Coupled circuits-self and mutual inductance, coefficient of coupling, DOT convention; series and parallel connection of coupled coils, equivalent circuits of coupled coils; energy in coupled circuit; analogy between electrical and magnetic circuits.

UNIT-V: PASSIVE FILTERS **(8 Periods)**
Classification of filters, filter networks, analysis of filter networks - attenuation, phase shift, characteristic impedance in pass band and stop band, constant-*K* low pass & high pass filters, *m*-derived filters, band pass & band elimination filters. Design of filters.

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*, 5th Edition, McGraw Hill Education (India) Private Limited, New Delhi, 2013.
2. A. Sudhakar, Shyammohan S Palli, *Circuits and Networks Analysis and Synthesis*, 5th Edition, McGraw Hill Education (India) Private Limited, NewDelhi, 2015.

REFERENCE BOOKS:

1. J. A. Edminister, M. D. Nahvi, *Theory and Problems of Electric Circuits*, 4th Edition, Schaum's outline series, McGraw Hill, New Delhi, 2004.
2. W. H. Hayt, J E Kemmerly, S M Durbin, *Engineering Circuit Analysis*, 8th Edition, McGraw Hill, New Delhi, 2008.

I B. Tech. - II Semester

(19BT1BS32) **ENGINEERING CHEMISTRY LAB**

(Common to EEE, ECE and EIE)

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

PRE-REQUISITES: -

COURSE DESCRIPTION: Estimation of hardness, alkalinity, dissolved oxygen of water samples, Iron, Strength of an acid in Pb-acid battery and residual chlorine in drinking water by volumetric methods; Measurement of viscosity of lubricants; Instrumental methods like conductivity meter, potentiometer, P^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 or 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 EEE, ECE and EIE)

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

PRE-REQUISITES: -

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

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

CO1. Demonstrate knowledge of Phonetics by examining and applying sounds of English in Phonetic Transcription.

CO2. Analyze sentence structures by applying and demonstrating the skills of Vocabulary and Grammar.

CO3. Apply appropriate listening and reading skills by analyzing the context and demonstrate in Listening Comprehension and Reading Comprehension.

CO4. Function effectively as an individual and as a member in diverse teams examining and applying speaking skills in Just A Minute and Role Play.

CO5. Communicate effectively applying appropriate writing and speaking techniques by examining and demonstrating knowledge through Describing Objects, Information Transfer and Letter Writing.

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 - 3rdEdition
10. Centro nix – Phonetics
11. Let's Talk English, Regional Institute of English South India.

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

I B. Tech. – II Semester

(19BT10331) **COMPUTER AIDED ENGINEERING DRAWING**

(Common to EEE, ECE and EIE)

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

PRE-REQUISITES:--

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

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

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

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

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

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 & Rajashekar Patil, *Computer Aided Engineering Drawing*, New Age International Publishers, 4th Edition, 2012.

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

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

PRE-REQUISITES: A course on Basic Mathematics.

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

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

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

PRACTICAL EXERCISES:

1) a) Design a script in Scratch to simulate Airplane for take-off and land.
   b) Design a script in Scratch to make a sprite to ask the user to enter two different numbers and an arithmetic operator and then calculate and display the result.

2) a) Design a script in Scratch to calculate factorial of a given number.
   b) Design a script in Scratch to simulate Maze game. (Hint: To get Maze images refer http://inventwithScratch.com/downloads/)

3) a) Write a python script to read two integer numbers and perform arithmetic operations.
   b) Write a python script to evaluate following expressions by considering necessary inputs.
   i) $ax^2 + bx + c$ ii) $ax^5 + bx^3 + c$ iii) $(ax + b) / (ax - b)$ iv) $x - a / b + c$

4) a) Write a python script to convert given decimal number into octal, hexa decimal and binary.
   b) Write a python script to read four integer values separated with commas and display the sum of those four numbers.
   c) Write a python script to print “SVEC” with prefix of ten spaces by using format().

5) a) Write a python script to calculate electricity bill based on following slab rates.

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 primesquare(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 dataframe using list of lists.

b) Write a python script to load data from a CSV file into a Pandas DataFrame and perform basic operations on it.

10) a) Draw a Scatter Plot by considering an appropriate data set.

b) Draw histograms by considering an appropriate data set.

11) **Mini Project-1**

12) **Mini Project-2**

TEXT BOOK:

1. R. Nageswara Rao, *Core Python Programming*, 2^{nd} Edition, Dreamtech Press, 2018.

I B. Tech. – II Semester
(19BT20231) **ELECTRIC CIRCUITS LAB**

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

PRE-REQUISITES: A course on Physics at Intermediate Level.

COURSE DESCRIPTION: Practical investigations on DC, single and poly phase circuits, Circuit theorems, magnetically coupled circuits and Two-Port networks.

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

CO1. Analyze various electrical circuits by applying the principles of network reduction techniques, mesh and nodal analysis.

CO2. Analyze the single, poly phase and coupled circuits to investigate the response and to determine various electrical quantities.

CO3. Analyze various electrical circuits, by applying circuit theorems to determine the response for DC and AC excitations.

CO4. Design an appropriate filter network for the given specifications.

CO5. Work independently or 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. Analysis of RL, RC and RLC circuits.
4. Current locus diagram of RL and RC circuits.
5. Analysis of Series and Parallel resonance.
6. Measurement of active and reactive power in three phase circuits.
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 & AC excitations.
10. Determination of self and mutual inductance and coefficient of coupling.
11. Design and analysis of Low pass filter.
12. Design and analysis of High pass filter.

REFERENCE BOOKS/ LAB MANUALS:

1. P. S. Dhogal, *Basic Practicals in Electrical Engineering*, Standard Publishers, 2004.
2. Yannis Tsividis, *A First Lab in Circuits and Electronics*, Wiley, 1stEdition, 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) (7 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) (9 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 (8 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 EEE, ECE and EIE)

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

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

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

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

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

DETAILED SYLLABUS:

UNIT-I: LINEAR& NONLINEAR WAVE SHAPING (9 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 (9 Periods)
Transistor modeling using h-Parameters, CE, CB and CC circuit analysis using h-parameters, Simplified hybrid model, Comparison of CB, CE and CC circuits, Analysis of CE amplifier with emitter resistance.

UNIT-IV: FIELD EFFECT TRANSISTOR (10 Periods)
Construction, Operation and characteristics of JFET, Enhancement MOSFET & Depletion MOSFET, FET Biasing-Gate bias, Self bias, voltage divider bias, FET equivalent circuit, CS,CD and CG amplifiers, comparison of BJT & FET.

UNIT-V: SPECIAL PURPOSE ELECTRONIC DEVICES (7 Periods)
Tunnel Diode, Varactor Diode, Unijunction Transistor (UJT),UJT as Relaxation Oscillator, DIAC, TRIAC, Silicon Controlled Rectifier.

Total periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Jacob Millman, Herbert Taub and 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 andCircuits*, PHI, 10thEdition, 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
(19BT30201) ELECTRICAL MACHINES-I

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

PRE-REQUISITES: Courses on Basic Electrical and Electronics Engineering and Electric Circuits.

COURSE DESCRIPTION: Construction, operation, types, performance characteristics and applications of DC machines and transformers.

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

CO1. analyse the DC generator to evaluate various operating parameters and develop constructional features for sustainability.

CO2. analyse the operational characteristics of various DC generators to assess measures for sustainability.

CO3. analyse the performance characteristics of various types of DC motors to develop accessories and assess the suitability for industrial applications.

CO4. analyse the equivalent circuits of transformers with various configurations to determine their performance and assess sustainability for various load conditions.

DETAILED SYLLABUS:

UNIT-I: DC GENERATORS (9 Periods)

Principle of operation and constructional details of DC generator. Armature windings — lap and wave, simplex and multiplex, single layer and multi-layer, equalizer rings and dummy coils.EMF equation and methods of excitation. Losses — constant, variable and minimization of losses. Calculation of efficiency — condition for maximum efficiency.

UNIT-II: ARMATURE REACTION, COMMUTATION AND CHARACTERISTICS (9 Periods)

Armature reaction — cross magnetizing and de-magnetizing AT/pole; compensating winding. Commutation — reactance voltage and methods of improving commutation. Build-up of EMF in a self-excited DC generator; causes for failure of self-excitation and remedial measures. Internal and external characteristics of DC generators and applications.

UNIT-III: DC MOTORS (9 Periods)

Principle of operation of DC motor; Back EMF& its significance; speed and torque equation. Characteristics and applications of shunt, series and compound motors. Speed control of DC shunt and series motor. Electric braking; Starters for DC Motors (2-, 3- and 4-point) and their design.

UNIT-IV: SINGLE PHASE TRANSFORMERS (10 Periods)

Introduction — classification of transformers, cooling methods, ideal and practical transformers; operation on no-load and on-load, phasor diagrams; losses, equivalent circuit, efficiency and regulation; Effects of variation of frequency and supply voltage on iron losses. All-day efficiency. Auto transformers — equivalent circuit, comparison with two winding transformers.

UNIT-V: THREE-PHASE TRANSFORMERS (8 Periods)

Three-phase transformers — construction and connections — Y/Y, Y/Δ, Δ/Y, Δ/Δ, open-Δ and Scott connections. Three winding transformers — tertiary windings; determination of ZP, Zs and ZT;OFF-load and ON-load tap changing.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. JB Gupta, *Theory and performance of Electrical Machines* (DC machines, Poly phase Circuits & AC machines) in SI Units, S.K. Kataria & Sons, New Delhi, 15th Edition, 2015.
2. R.K. Rajput, *Electrical Machines* in S.I. Units, Laxmi Publications (P) Ltd, 6th Edition, New Delhi, 2017.

REFERENCE BOOKS:

1. P.S. Bimbhra, *Electrical Machinery*, Khanna Publishers, 7th Edition, Delhi, 2011.
2. B.L. Theraja and A.K. Theraja, *A Text Book of Electrical Technology(in S. I. Units)*, Vol.2, S. Chand & Company Ltd, Multicolour illustrative Edition, New Delhi, 2014.

ADDITIONAL LEARNING RESOURCES:

1. http://www.nptelvideos.in/2012/11/electrical-machines-i.html
2. https://nptel.ac.in/courses/108/102/108102146/
3. https://freevideolectures.com/course/3085/electrical-machines-i
4. https://www.youtube.com/playlist?list=PL9RcWoqXmzaJpnkjoNleyFNgGk9-znOji

II B. Tech. – I Semester
(19BT30202) ELECTROMAGNETIC FIELDS

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

PRE-REQUISITES: Courses on Differential Equations and Multivariable Calculus, and Engineering Physics.

COURSE DESCRIPTION: Static electric fields; Gauss's law and its applications; Potential and Potential Gradient; steady magnetic fields; Ampere's circuital law and its applications; Force in magnetic fields; behaviour of various materials in electric and magnetic fields; Inductance and capacitance calculations; Maxwell's equations for time variant and time invariant fields.

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

CO1. Analyse the static electric field to determine electric field for various charge configurations by applying the laws of electrostatics.

CO2. Analyse the static magnetic field to determine magnetic field and force due to various current carrying elements by applying the laws of magneto statics.

CO3. Analyse the time varying electric and magnetic fields by applying the laws of electromagnetic.

DETAILED SYLLABUS:

UNIT-I: ELECTROSTATICS - I (12 Periods)

Introduction to electrostatic fields, coulomb's law in vector form, electric field intensity (EFI), EFI due to various charge distributions, electric flux density, Gauss's law, application of Gauss's law - symmetrical charge distributions, differential volume element, Maxwell's first equation in point and integral form. Energy expended in moving a point charge in an electric field, electric potential, potential for different charge distributions, potential gradient, Maxwell's second equation in point and integral form.

UNIT-II: ELECTROSTATICS – II (10 Periods)

Electric Dipole, dipole moment, Potential and EFI due to an electric dipole. Current density, conduction and convection current density, Ohm's law in point form, current continuity equation, conductors and dielectric materials, properties, boundary conditions between conductor and dielectric material, two perfect dielectric materials, law of refraction, capacitance, capacitance of a parallel plate capacitor (with and without composite dielectric), energy density in electrostatic field, Poisson's and Laplace's equations.

UNIT-III: MAGNETOSTATICS (9 Periods)

Introduction to Magnetic fields, relation between magnetic flux density and magnetic Field Intensity (MFI), Biot-Savart's law, MFI due to various current carrying elements, Ampere's Circuital law, Maxwell's third equation in point and integral form, applications of Ampere's Circuital law - infinite line current, infinite sheet of current, solenoid and toroid. Maxwell's fourth equation in point and integral form. Scalar magnetic potential and vector magnetic potential.

UNIT-IV: FORCE IN MAGNETIC FIELDS (8 Periods)

Force due to magnetic fields, Lorentz force equation, force on a straight and long current carrying conductor in a magnetic field, force between two straight long and parallel current carrying conductors. Torque on a current loop placed in a magnetic field, magnetic dipole and magnetic dipole moment, magnetic boundary conditions between different magnetic materials. Self-inductance of a solenoid, toroid and co-axial cable, energy density in magnetic field.

UNIT-V: TIME VARYING FIELDS (6 Periods)

Introduction to time varying fields, Faraday's laws of electromagnetic induction, statically and dynamically induced EMF, concept of displacement current, modifications of Maxwell's equations for time varying fields, Poynting theorem.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. William H. Hayt and John A. Buck, *Engineering Electromagnetics,*8th Edition, McGraw Hill Education (India)Pvt. Ltd. 2014.
2. Matthew N.O. Sadiku, *Principles of Electromagnetics,* 4th Edition, Oxford University Press, New Delhi, 2007.

REFERENCE BOOKS:

1. Joseph A. Edminister, *Theory and Problems of Electromagnetics*, Schaum's Outline Series, Tata McGraw Hill Inc., New Delhi, 2009.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/106/108106073/
2. https://nptel.ac.in/courses/108/104/108104087/

II B. Tech. – I Semester
(19BT30203) **SIGNALS AND NETWORKS**

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

PRE-REQUISITES: Courses on Transformation Techniques and Linear Algebra and Electric circuits.

COURSE DESCRIPTION: Discrete and continuous time signals; Signal transformation methods — circuit applications; Analysis of Transients and Two-port networks.

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

CO1. Perform various operations on signals and evaluate their characteristics.
CO2. Analyze spectral characteristics of signals and circuits using Fourier, Laplace and z-Transforms.
CO3. Analyze transient behaviour of DC & AC circuits by using differential equations and Laplace transform methods.
CO4. Analyze network parameters of an isolated and interconnected two-port network.

DETAILED SYLLABUS:

UNIT-I: DISCRETE AND CONTINUOUS TIME SIGNALS (10 Periods)
Continuous and discrete signals: Test signals — Unit step, ramp, parabolic, unit impulse and exponential signals; Basic operation on signals— Time and Amplitude scaling; Classification of Signals — Periodic and a periodic signals, Odd and even components, Energy and power signals.

UNIT-II: TRANSFORMATION OF SIGNALS: Fourier Transforms (8 Periods)
Fourier series: Review of Fourier series, Trigonometric Fourier Series, properties of Fourier series (Without proof), Fourier series of common signals — amplitude and phase spectrum, Circuit Applications — Average value, RMS Values, average power and response.
Fourier transforms— Definition, properties of Fourier transforms (Without proof); Fourier transform of periodic signals; inverse Fourier transform. Applications — Circuit analysis and Parseval's theorem.

UNIT-III: TRANSFORMATION OF SIGNALS: Laplace and z-Transforms (10 Periods)
Laplace transforms: Review of Laplace transform, Laplace transform of periodic signals, properties of the Laplace transform(Without proof)—initial and final value theorems (without proof) and convolution, Region of convergence. Applications — Circuit analysis.
Z-Transforms: z-Transform, Region of convergence for the z-Transform, inverse z-Transform; Properties of the z-Transform—Initialand final value theorem (without proof) and convolution; Application: z-Transform solution of linear difference equations.

UNIT-IV: TRANSIENT ANALYSIS (9 Periods)
DC Transients: Initial conditions; Transient response of RL, RC and RLC circuits.

AC Transients: Transient response of RL, RC and RLC circuits; solution methods using differential equation and Laplace transforms.

UNIT-V: TWO-PORT NETWORKS **(8 Periods)**

Network Functions — Driving point and transfer functions; Network parameters — Impedance, Admittance, Transmission and Hybrid parameters. Symmetry and reciprocity property in two-port networks; Interrelationships of different parameters; Inter-connection of two-port networks.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Lathi & Bhagw and as Pannalal, *Principles of Linear Systems and Signals,* Oxford University Press, 2nd Edition, 2009.
2. Charles K. Alexander & Matthew N. O. Sadiku, *Fundamentals of Electric Circuits,* McGraw-Hill education Private Limited, New Delhi, 5th Edition, 2013.

REFERENCE BOOKS:

1. Matthew N Sadiku, and Warsame Hassan Ali, *Signals and Systems: A Primer with MATLAB,* CRC Press, 2016.
2. A Chakrabarthi, *Network Analysis and Synthesis,* Dhanpat Rai & Co., New Delhi, 2nd revised Edition, 2016.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/117/101/117101055/
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/

II B. Tech. – I Semester

(19BT3HS31) **SOFT SKILLS LAB**

(Common to CE, ME, EEE, ECE and EIE)

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

PRE-REQUISITES: -

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

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

CO1. Demonstrate knowledge of career skills by examining and applying the styles and strategies of Goal Setting, Thinking Skills, and Etiquettes.

CO2. Analyze the limitations and possibilities of favourable situations by applying the skills of Body Language and demonstrate through Assertiveness, and Interpersonal Skills.

CO3. Apply appropriate soft skills by analyzing the problem situations that arise in professional career through demonstrating remedies in Conflict Management.

CO4. Demonstrate ability to function effectively as an individual and as a member in diverse teams examining and applying soft skills in Interviews, Group Discussion and Team Building.

CO5. Apply appropriate speaking and writing techniques in preparing documents and to communicate effectively by examining and demonstrating knowledge in Technical Report Writing and Résumé Writing.

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 BOOKS:

1. Soft Skills Lab Manual, SVEC.

REFERENCE BOOKS:

1. R. C. Sharma & Krishna Mohan, *Business Correspondence and Report Writing*, Tata Mc Graw-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 EEE, ECE and EIE)

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

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

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

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

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

List of Exercises/List of Experiments: Minimum Ten Experiments are to be conducted.

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

REFERENCE BOOKS/LABORATORY MANUALS:

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

SOFTWARE/Tools used: --

ADDITIONAL LEARNING RESOURCES:

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

II B. Tech. – I Semester
(19BT30231) **ELECTRICAL MACHINES-I LAB**

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

PRE-REQUISITES: Courses on Basics of Electrical and Electronics Engineering Lab and Electric circuits.

COURSE DESCRIPTION: Speed control and performance characteristics of DC Machines; Determination of losses and performance evaluation of DC machines and transformers.

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

CO1. Evaluate the operating characteristics of DC generators and validate the practical observations with the underlying concepts.

CO2. Evaluate the operating characteristics of DC motors and validate the practical observations with the underlying concepts.

CO3. Realize the philosophy of testing procedures of various DC machines and transformers by adhering the code of conduct.

CO4. Evaluate the operating characteristics of transformers and validate the practical observations with the underlying concepts.

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. OCC of DC shunt generator.
2. Load test on DC shunt generator.
3. Brake test on DC Shunt and Compound Motors.
4. Speed control of DC shunt motor.
5. Swinburne’s test.
6. Hopkinson's test.
7. Electric braking of DC motor.
8. OC and SC tests on 1-Phase transformer.
9. Separation of core losses in a 1-Phase transformer.
10. Sumpner's test.
11. Parallel operation of1-Phase transformers.
12. Scott connection.

TEXT BOOKS:

1. JB Gupta, *Theory and performance of Electrical Machines*(DC machines, Poly phase Circuits & AC machines) in SI Units, S.K. Kataria & Sons, New Delhi, 15th Edition, 2015.
2. R.K. Rajput, *Electrical Machines* in S.I. Units, Laxmi Publications (P) Ltd, 6th Edition, New Delhi, 2017.

REFERENCE BOOKS:

1. P.S. Bimbhra, *Electrical Machinery*, Khanna Publishers, 7th Edition, Delhi, 2011.

2. B.L. Theraja and A.K. Theraja, *A Text Book of Electrical Technology (in S. I. Units)*, Vol.2, S. Chand & Company Ltd, Multicolour illustrative Edition, New Delhi, 2014.

ADDITIONAL LEARNING RESOURCES:

1. http://vlabs.iitb.ac.in/vlabsdev/vlab_bootcamp/bootcamp/Sadhya-/experimentlist.html
2. http://emcoep.vlabs.ac.in/List%20of%20experiments.html?domain=Electrical%20Engineering

II B. Tech. – I Semester
(19BT30232) **SIGNALS AND NETWORKS LAB**

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

PRE-REQUISITES: Courses on Transformation techniques and linear algebra and Electric circuits.

COURSE DESCRIPTION: Practical investigations through simulation on signals and systems; Spectral analysis of signals, and analysis of transients and two-port networks.

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

CO1. Evaluate, analyze the characteristics/responses of various signals and systems, and interpret the practical observations for validation.
CO2. Analyze spectral characteristics of signals/response in frequency domain using Fourier, Laplace and z-Transforms.
CO3. Analyze transient behavior of DC & AC circuits using mathematical methods and design timer circuits for desired specifications.
CO4. Analyze network parameters of an isolated and interconnected two-port networks and design impedance and gain matching networks.
CO5. Work independently or in teams to solve problems with effective communication.

Practical Exercises/List of Experiments: Minimum Five experiments are to be conducted from each part.

PART-A:

1. Generation of continuous and discrete time signals.
2. Basic operations on continuous and discrete time signals — Time scaling and amplitude scaling.
3. Systems and their properties — Linearity, causality and stability.
4. Response of LTI systems for different excitations.
5. Analysis of signals — Amplitude and Phase spectrum.
6. Convolution in frequency domain — Laplace and z-transforms.

PART-B:

7. Transient response of RL circuit and design of timer circuit.
8. Transient response of RC circuit and design of timer circuit.
9. Transient response of RLC circuit and applications.
10. Determination of two-port network parameters in an isolated networks — Z, Y, ABCD and h-Parameters.
11. Determination of two-port network parameters in an interconnected networks — Series-Series, Parallel-Parallel and cascaded interconnections.
12. Design of impedance matching two-port network.

TEXT BOOKS:

1. Lathi & Bhagwandas Pannalal, *Principles of Linear Systems and Signals,* Oxford University Press, 2nd Edition, 2009.

2. Charles K. Alexander & Matthew N. O. Sadiku, *Fundamentals of Electric Circuits,* McGraw-Hill education Private Limited, New Delhi, 5th Edition, 2013.

REFERENCE BOOKS:

1. Matthew N Sadiku, and Warsame Hassan Ali, *Signals and Systems: A Primer with MATLAB,* CRC Press, 2016.
2. Alex Palamides Anastasia Veloni, *Signals and Systems Laboratory with MATLAB*, CRC Press Taylor & Francis Group, 2011.

ADDITIONAL LEARNING RESOURCES:

1. http://ssl-iitg.vlabs.ac.in/
2. https://nptel.ac.in/courses/117/101/117101055/
3. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/

II B. Tech. – I Semester

(19BT3MC01) **ENVIRONMENTAL SCIENCE**

(Mandatory Course)

(Common to EEE, ECE and EIE)

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

PRE-REQUISITES:-

COURSE DESCRIPTION: Natural resources; Eco systems; Bio diversity; 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 (7 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 (7 Periods)

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

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

UNIT-III: ENVIRONMENTAL POLLUTION AND CONTROL (6 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 (6 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 (4 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
(19BT40441) **ANALOG ELECTRONICS**

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

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

COURSE DESCRIPTION: Demonstrate Single Stage Amplifiers; Multi Stage amplifiers; Frequency Response; Negative Feedback Amplifiers; Oscillators; Multi vibrators; Large Signal 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 the concept of feedback to improve the stability of amplifiers and generate sustained oscillations.

CO3. Realize different classes of Power Amplifiers to improve efficiency.

CO4. Design filters to find the frequency response and operate IC555 in various modes for different applications.

DETAILED SYLLABUS:

UNIT-I: BJT AMPLIFIERS (11 Periods)

Classification of Amplifiers, Distortion in amplifiers, Analysis of Single Stage Common Emitter Amplifier- Frequency Response, Different coupling schemes used in multistage amplifiers, Effect of coupling and bypass capacitors on frequency response, Multistage Frequency Effects, Analysis of Two stage RC Coupled amplifier, Cascode amplifier, Darlington pair, Bootstrapped Darlington circuit, Hybrid- Pi (π)- Common Emitter model.

UNIT-II: NEGATIVE FEEDBACK AMPLIFIERS (9 Periods)

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

UNIT-III: OSCILLATORS (8 Periods)

Conditions for oscillations, Classification, RC phase shift oscillator using BJT and FET, Wien bridge oscillator using BJT, Generalized analysis of LC oscillators, Hartley and Colpitts Oscillators, Crystal Oscillator, Frequency stability.

UNIT-IV: LARGE SIGNAL AMPLIFIERS (8 Periods)

Classification, Series fed Class A Power Amplifier- Power conversion Efficiency, Transformer Coupled class A power Amplifier, Push Pull and Complimentary Symmetry Class B power amplifier, Class AB operation, Principle of operation of class –C Amplifier, Transistor Power Dissipation, Heat Sinks.

UNIT-V: ACTIVE FILTERS AND 555 TIMER (9 Periods)

Analog Filters: Introduction, RC Active Filters- first order and second order all pass, Low pass & high pass, Band pass and Band reject using Op-Amp.

IC 555 Timer: Introduction to 555 Timer, functional diagram, Monostable Operations, Astable operations & their applications.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Jacob Millman, Christos C. Halkias and Satyabrata Jit , *Integrated Electronics,* McGraw-Hill Education, 3nd Edition, 2010.
2. Ramakanth A. Gayakwad, *Op-Amps & Linear ICs*, PHI, 3rd Edition, 1998

REFERENCE BOOKS:

1. Adel S.Sedra, Kenneth C.Smith ,Micro Elctronic Circuits Theory and applications, OXFORD international student Edition 5th Edition, ,2009
2. Robert L. Boylestad and Louis Nashelsky, *Electronic Devices and Circuits Theory*, Pearson Education, 10th Edition, 2009.
3. D. Roy Chowdhury, *Linear Integrated Circuits*, New Age International (p) Ltd, 4thEdition, 2011.

II B. Tech – II Semester
(19BT40201) DIGITAL ELECTRONICS

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

PRE-REQUISITES: A course on Electronic Devices and Circuits.

COURSE DESCRIPTION: Boolean algebra; Minimization techniques; Analysis of digital circuits; Asynchronous Sequential Logic, Programmable Memories and Computer arithmetic.

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

CO1. Design logical circuits by analyzing various Boolean functions and simplification methods to perform desired logical operations using logical gates.
CO2. Design combinational logical circuits for performing various arithmetic operations and data encoding and decoding in various data lines.
CO3. Analyze various sequential circuits for realizing counters and registers using flip-flops.
CO4. Analyze clocked sequential circuits using various techniques and realize design procedures for optimal circuits.
CO5. Design programmable logic devices for required memory and develop various computer algorithms for arithmetic operations.

DETAILED SYLLABUS:

UNIT-I: BOOLEAN ALGEBRA & LOGIC GATES (11 Periods)
Boolean Algebra-Basic definition, Basic theorems and properties, Boolean Functions, Canonical & Standard forms, the map method, four variable, Five variable K-map, POS& SOP Simplification, Don't care conditions.
Logic Gates: Logic operations & Logic gates, NAND & NOR Implementation, Other two level Implementation.

UNIT-II: COMBINATIONAL CIRCUITS (8 Periods)
Combinational circuits, Analysis & Design procedure, Binary Adder-Subtractor, Decimal Adder, Binary Multiplier, Magnitude comparator, Decoder, Encoders, Multiplexers, Demultiplexers-1-Line to 4-Line and 1-Line to 8-LineDe-multiplexers.

UNIT-III: SEQUENTIAL CIRCUITS-I (9 Periods)
Sequential Circuits, Latches, Flip-Flops, conversions, Clocked sequential circuits, Registers-Shift Registers, Counters- Synchronous counters and Asynchronous counters.

UNIT-IV: SEQUENTIAL CIRCUITS -II (8 Periods)
Analysis of Clocked sequential circuits– Mealy & Moore circuits, design procedure, State Reduction & Assignment- partition technique, merger chart & merger table, Hazards.

UNIT-V: PROGRAMMABLE MEMORIES&COMPUTER ARITHMETIC (9 Periods)
Programmable Memories: ROM,PLA, PAL.
Computer Arithmetic: Addition and Subtraction, Multiplication and Division Algorithms

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. A. Anand Kumar, *Switching Theory and Logic Design*, PHI, 2008.
2. M. Morris Mano, *Digital Design*, Pearson, 5^{th} Edition, 2013.

REFERENCE BOOKS:

1. ZviKohavi and NirahK.Jha, *Switching theory and Finite Automata Theory*, Tata McGraw-Hill, 2^{nd} Edition, 1978.
2. Charles H. Roth, *Fundamentals of Logic Design*, Thomson Publications, 5^{th}Edition, 2004.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/117/101/117101055/
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/

II B. Tech. – II Semester
(19BT40202) **ELECTRICAL MACHINES-II**

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

PRE-REQUISITES: Courses on Electrical Machines-I and Electrical Machines-I Lab.

COURSE DESCRIPTION: Construction, types, operation and applications of induction machines and synchronous machines; parallel operation of synchronous generators; Performance evaluation of induction machines and synchronous machines.

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

CO1. Analyze the performance of induction machine to evaluate the operating parameters and to asses feasible control strategies.

CO2. Analyze the performance of synchronous generator to evaluate the operating parameters and to assess measures for sustainability.

CO3. Analyze the synchronized operation of alternators and the effect of influencing factors on synchronization, and to determine feasible operating state for sustainability.

CO4. Analyze the performance of synchronous motor to evaluate the operating parameters, and to determine sustainable and feasible operating states for various loadings.

DETAILED SYLLABUS:

UNIT-I: THREE PHASE INDUCTION MOTORS (9 Periods)

Production of rotating magnetic field in 3-phase Induction motor, slip, rotor EMF and rotor frequency, rotor reactance, rotor current and power factor at standstill and running conditions; ratio of full-load torque and maximum torque, ratio of starting torque and maximum torque; losses in 3-phase induction motor, relation between rotor power input, rotor copper loss and mechanical power developed. Induction motor as a generalized transformer. Double-cage and deep bar rotors.

UNIT-II: STARTING AND SPEED CONTROL METHODS (9 Periods)

Methods of starting — starting current and torque calculations for direct online, primary resistors, auto transformer and star-delta starters; Crawling and Cogging; Speed control — change of frequency, voltage and stator poles, rotor rheostat control, cascade connection and injection of EMF into rotor circuit. Induction generator — principle of operation and its applications.

UNIT-III: SYNCHRONOUS GENERATORS (10 Periods)

Armature windings — integral slot and fractional slot, distributed and concentrated, short pitch and full pitch, winding factors; EMF equation, harmonics in generated EMF and suppression of harmonics. Armature reaction and its effect for various operating power factors.— phasor diagrams; Power flow equations in synchronous generator. Salient pole alternators —two-reaction theory, phasor diagrams and voltage regulation.

UNIT-IV: PARALLEL OPERATION OF SYNCHRONOUS GENERATORS (10 Periods)
Conditions for parallel operation; methods of synchronization; Synchronizing current, power and torque, rigidity factor. Effect of change of excitation and mechanical power input on parallel operation of two alternators, load sharing between two alternators; Synchronous machines on infinite bus bars. Short Circuit Ratio (SCR) and its significance. Time period of rotor oscillations.

UNIT-V: THREE PHASE SYNCHRONOUS MOTORS (7 Periods)
Principle of operation; starting methods —auxiliary motor, damper winding, synchronous-induction motor. Phasor diagrams; Variation of armature current and power factor with excitation; synchronous condenser. Power flow equations in synchronous motor. Circle diagram —excitation and power circles. Hunting and its suppression.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. P.S. Bimbhra, *Electrical Machinery*, 7th Edition, Khanna Publishers, New Delhi, 2011.
2. JB Gupta, *Theory and performance of Electrical Machines (DC machines, Poly phase circuits & AC machines) in SI Units*, 15th Edition,S.K. Kataria & Sons, New Delhi, 2015.

REFERENCE BOOKS:

1. A.E. Fitzgerald, C. Kingsley and S. Umans, *Electric Machinery*, 6th Edition, McGraw-Hill, New Delhi, 2008.
2. B.L. Theraja and A.K. Theraja, *A Text Book of Electrical Technology in S. I. Units*, Vol.2, S.Chand Company Ltd, Multicolour Edition, New Delhi, 2014.

II B. Tech. – II Semester
(19BT40203) ELECTRICAL MEASUREMENTS

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

PRE-REQUISITES: A course on Electric Circuits.

COURSE DESCRIPTION: Measurement of electrical quantities; construction, working, design and applications of various electrical measuring instruments; Performance evaluation of various electrical measuring instruments.

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

CO1. Understand the constructional and operating principles of various measuring instruments and design an appropriate shunt and multiplier for the extension of instrument range.

CO2. Analyze various errors, while measuring the electrical quantities due to interconnection of power, energy and power factor measuring instruments and assess the error compensation techniques.

CO3. Analyze various errors, while measuring the electrical quantities due to interconnection of instrument transformers and potentiometers, and assess the error compensation techniques.

CO4. Analyze the phasor of various electrical bridges used for measuring, to estimate various electrical quantities.

CO5. Analyze the patterns of various monitoring instruments to determine the phase and frequency of various electrical signals.

DETAILED SYLLABUS:

UNIT-I: MEASUREMENT OF VOLTAGE AND CURRENT (11 Periods)

Types of measuring instruments; Methods of measurements; Static characteristics — limiting and relative limiting errors and combination of quantities with limiting errors; Types of errors. PMMC and MI instruments — Construction, working, torque equation, extensions, errors, compensations, and advantages and disadvantages.

UNIT-II: MEASUREMENT OF POWER, ENERGY ANDPOWERFACTOR (8 Periods)

Measurement of power: EDM wattmeter — construction, working, torque equation, shape of scale, errors and compensations; LPF wattmeter.

Measurement of energy: Single phase induction type energy meter—construction, working, driving and braking torques, lag adjustment devices, errors and compensations. Three phase energy meter.

Measurement of power factor: Power factor meter — single phase and three phase electrodynamometer type.

UNIT-III: INSTRUMENT TRANSFORMERS AND POTENTIOMETERS (10 Periods)

Current and Potential transformers — construction, working, phasor diagram, errors and characteristics; Measurement of power using instrument transformers,

DC Potentiometers: Basics lide wire potentiometer circuit, DC Crompton's potentiometer —principle, operation, standardization and applications.
AC Potentiometers: Polar and coordinate type potentiometers — Principle, operation, standardization and applications.

UNIT-IV: DC AND AC BRIDGES (6 Periods)
Measurement of resistance: Wheatstone bridge-Sensitivity of Wheat stone's bridge, Kelvin's double bridge and loss of charge method.
Measurement of inductance & quality factor: axwell's inductance bridge, Hay's bridge, Anderson's bridge and Owens's bridge
M**easurement of capacitance & loss angle:** De-sauty's bridge, Schering bridge and modified Schering bridge.
Measurement of frequency: Wien's bridge.

UNIT-V: CRO AND DIGITAL INSTRUMENTS (10 Periods)
Cathode ray oscilloscope: Introduction, cathode ray tube, time base generator, horizontal and vertical amplifiers, measurement of phase and frequency by Lissajous patterns.
Digital instruments: Digital voltmeters and types (ramp, integrating, successive approximation), Digital energy meter, Digital storage oscilloscope, Digital frequency meter, Digital multi-meters and Digital tachometer.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. A.K. Sawhney, A course on *Electrical and Electronics Measurements & Instrumentation*, Dhanpatrai and Co. Publishers, 19th Edition, 2015.
2. J.B. Gupta, A course on *Electrical and Electronics Measurements & Instrumentation*, S.K. Kataria publishers, 14thEdition, 2014.

REFERENCE BOOKS:

1. H. S. Kalsi, *Electronic Instrumentation*, Tata MC Graw Hill Company, 3rd Edition, 2010.
2. E.W. Golding and F.C. Widdis, *Electrical Measurements and measuring Instruments,* Reem Publications, 5th Edition, 2011.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105153/

II B. Tech. – II Semester
(19BT40204) TRANSMISSION AND DISTRIBUTION

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

PRE-REQUISITES: Courses on Electromagnetic Fields, and Signals and Networks.

COURSE DESCRIPTION: Parameters of overhead transmission lines and underground cables; Performance of transmission lines, travelling wave phenomenon; Insulators; Sag and corona; Distribution systems classification, analysis and planning.

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

CO1. Analyze the overhead lines and underground cables to evaluate various parameters and their characteristics for different configurations.

CO2. Analyze the performance of transmission lines and investigate the behaviour of travelling waves for different configurations of transmission lines.

CO3. Analyze the mechanical and electrical aspects of overhead transmission lines and realize measures for sustainability.

CO4. Analyze various distribution systems, to determine their performance characteristics under various scenarios.

CO5. Realize various aspects of substation, and analyze the primary and secondary feeders systems of substation to configure the feeder layout in a service area.

DETAILED SYLLABUS:

UNIT-I: OVERHEAD TRANSMISSION LINE AND UNDERGROUND CABLES (11 Periods)

Overhead Transmission Lines: Overhead line and underground cables and its types, Parameters- resistance, inductance and capacitance calculations in single and three phase transmission lines, single and double circuits, symmetrical and unsymmetrical spacing, concepts of GMR and GMD-Effect of earth on capacitance.

Underground Cables: Construction, types of insulating materials, classification of cables, laying of cables, insulation resistance, capacitance of single and 3-core belted cables, grading of cables - capacitance and inter sheath grading.

UNIT-II: ANALYSIS OF TRANSMISSION LINES (11 Periods)

Modelling and Analysis of Transmission lines: Classification - short line, medium line and long line; equivalent circuits –end condenser, Nominal-T, Nominal-π models, rigorous method; ABCD constants, voltage regulation and efficiency of transmission lines.

Travelling waves on transmission lines: Travelling waves – open end line, short circuited line, Line terminated through a resistor, line connected to a cable, Line connected to a T-junction.

UNIT-III: MECHANICAL ASPECTS OF OVER HEAD LINE AND CORONA (8 Periods)

Insulators— Line supports, overhead line insulators, types of insulators, string efficiency and methods for improvement.

Sag in overhead line: Sag and tension calculations with equal and unequal heights of towers, effect of wind and ice on sag, stringing chart.
Corona: Corona phenomenon - factors affecting corona, critical voltages and power loss, advantages and disadvantages.

UNIT-IV: DISTRIBUTION SYSTEMS **(7 Periods)**
Classification and Characteristics—residential, commercial, agricultural and industrial loads.
Voltage drop calculations in DC distributors– radial DC distributor fed at one end, at both the ends (equal/unequal voltages) and ring main distributor.
Voltage drop calculations in AC distributors– power factors referred to receiving end voltage and respective load voltages.

UNIT-V: SUBSTATIONS **(8 Periods)**
Classification of substations — Indoor and outdoor, gas and air insulated substations; Substation layout, different bus bar schemes, location of substations and benefits through optimal location — rating of distribution substations, service area with 'n' primary feeders; Considerations of distribution feeder voltage levels: Radial and loop types of primary feeders and secondary feeders – Feeder loading – Basic design practice of the secondary distribution system.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Wadhwa, C. L. *Electrical power systems*. 7th Edition, New Age International Private limited, 2017.
2. Turan Gonen, *Electric Power Distribution System Engineering,* 3rd Edition CRC Press, Taylors and Francis Group, 2014.

REFERENCE BOOKS:

1. S.N. Singh, ‘Electric Power Generation, Transmission and Distribution’, Prentice Hall of India Pvt Ltd, New Delhi, 2002.
2. U.A.Bakshi and M.V.Bakshi, *Transmission and Distribution of Electrical Power*, Fourth revised Edition, Technical Publications, 2009.
3. J.B.Gupta, *A Course in Electrical Power*, 11th Edition, S.K.Kataria & sons, New Delhi 2013.
4. V.K.Mehta, Rohit Mehta, *Principles of Power System,* revised Edition, S.Chand & Company Ltd, 2013.

ADDITIONAL LEARNING RESOURCES:

1. Travelling Wave: https://www.eeeguide.com/travelling-waves-on-transmission-lines/
2. Travelling Waves Lecture: https://nptel.ac.in/courses/108/102/108102119/
3. Power System: https://nptel.ac.in/courses/108/105/108105104/
4. https://edisontechcenter.org/Transmission.html
5. http://www.minnelectrans.com/transmission-system.html
6. Distribution System: https://nptel.ac.in/courses/108/102/108102047/

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

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

PRE-REQUISITES: -

COURSE DESCRIPTION: Introduction to Material Science and Engineering; Composite Materials; Smart Materials; Nano and Biomimetic Materials; Emerging Materials.

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

CO1. Attain the basic knowledge on composites, smart materials, biomimetic materials and nano materials.

CO2. Demonstrate essential information about structure and properties of various composites used in various engineering applications.

CO3. Understand the basic properties of electro-rheostatic, magneto-rheostatic and shape memory alloys used in device applications.

CO4. Accomplish the basic knowledge in nano materials to familiarize various nano structured device applications.

CO5. Outline the processing and properties of functionally graded materials and identify its applications in various fields.

DETAILED SYLLABUS:

UNIT- I: INTRODUCTION TO MATERIAL SCIENCE AND ENGINEERING (8 Periods)

Introduction - historical perspective - material science and engineering, classification of materials (metals, ceramics, polymers and composites) and advanced materials and their applications (biomaterials, smart materials and nano materials), modern materials needs. Processing, properties and applications of metals, polymers and ceramics (Qualitative).

UNIT- II: COMPOSITE MATERIALS (10 Periods)

Composite Materials - Classification, Laminated composites and Reinforced composite materials – Classification, structure and properties of sandwich composites – applications (commercial Aircraft, Marine Grade Sandwich, Automobile Grade Sandwich and Wind Turbine Blades), properties and applications of Nano composites - Advantages and Limitations of composites.

UNIT- III: SMART MATERIALS (7 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 (9 Periods)

Introduction: Communication Basics - Functions of Communication – Communication Networks - Interpersonal Communication – Informal Communication - Communication Barriers - Roles of a Manager.

UNIT- II: CORPORATE COMMUNICATION (9 Periods)

Introduction: Corporate Communication - Cross-Cultural Communication; Concept & Styles - Corporate Communication Strategy - Corporate Citizenship - Crisis Communication: Case Study.

UNIT- III: WRITING BUSINESS MESSAGES &DOCUMENTS (9 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 (9 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 **(9 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 McGraw-Hill Education, Pvt. Ltd., New Delhi, 2012.

REFERENCE BOOKS:

1. Courtland L.Bovee et al., *Business Communication Today*, Pearson, New Delhi, 2011.
2. Krizan, *Effective Business Communication*, Cengage Learning, New Delhi, 2010.

ADDITIONAL LEARNING RESOURCES

1. http://www.career.vt.edu/interviewing/TelephoneInterviews.html
2. http://job-search-search.com/interviewing/behavioral_interviews
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 (9 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 (9 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 (9 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 (9 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 Organization (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 (9 Periods)

Concept of Women entrepreneur - Functions of Women entrepreneurs - Growth of women entrepreneurship in India - Challenges of Women entrepreneurs- Programmes supporting women entrepreneurship – Rural Entrepreneurship – Meaning, Need for Rural entrepreneurship, Problems of rural entrepreneurship, Role of NGOs, Role of Bharatiya Mahila Bank for encouraging Women Entrepreneurs – Micro Finance & Self Help Groups (Basic Concepts).

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Dr.S.S.Khanka*, Entrepreneurial Development*, S. Chand and Company Ltd, Revised Edition, 2012.
2. MadhurimaLall & ShikhaSahai, Entrepreneurship, Excel Books India, 4th Edition, 2014.

REFERENCE BOOKS:

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

II B. Tech. - II Semester
(19BT4HS06) GERMAN LANGUAGE
(Open Elective-1)
(Common to EEE, ECE and EIE)

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

PRE-REQUISITES: -

COURSE DESCRIPTION: Oral communication; Basic grammar; Basic writing; 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 (9 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 (9 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 (9 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 (9 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 (9 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 BOOKS:

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 (8 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 (9 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 (6 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: A course on Soft Skills Laboratory.

COURSE DESCRIPTION: Personalities and Leadership Qualities; Self Esteem and self-Development; Attitude; Communication Relationship; Critical Work Skills and Ethics.

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

CO1. Demonstrate knowledge of leadership qualities by examining and applying personality traits through Positive self-esteem, Open Communication and Self-Righteousness.

CO2. Analyze the limitations of Attitudes by applying and demonstrating communication traits through Decision Making, Ethics and Self-Actualization.

CO3. Apply appropriate analysing 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 (9 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 (9 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 (9 Periods)

Importance – Difference between Behavior and Attitude - Changing Negative Attitude-Impact of Attitudes on others - Unproductive Attitudes –Assess your Behaviour.

UNIT- IV: COMMUNICATION RELATIONSHIP (9 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 (9 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.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 (9 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 (9 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 (9 Periods)

Introduction- Present Scenario - Changes in Policy &Programme - National Plan of Action- Women's Cells and Bureau - Increase in work participation rate- Discrimination in labour market - Women in unorganized sector - Issues and Obstacles- Women in Education -

Women in Science & Technology - **Case Study:** Linking Education to Women's Access to resources.

UNIT- IV: WOMEN'S PARTICIPATORY DEVELOPMENT (9 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 (9 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(2017), "Women's Empowerment in India". Pointer Publishers, Jaipur
2. SahaySushama(2013), "Women and Empowerment" Discovery Publishing House, New Delhi.

REFERENCE BOOKS:

1. Baluchamy. S (2010), "Women's Empowerment of Women". Pointer Publishers, Jaipur.
2. KhobragadeGrishma (2020), "Women's Empowerment: Challenges and Strategies Empowering Indian Women, BooksclinicPublishing,Chhattisgarh.
3. https://www.economicsdiscussion.net/entrepreneurship/women-entrepreneurs-in-india
4. https://www.businessmanagementideas.com/entrepreneurship-2/women-entrepreneurs

II B. Tech. - II Semester

(19BT4HS14) **CONSTITUTION OF INDIA**

(Open Elective-1)

(Common to EEE, ECE and EIE)

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

PRE-REQUISITES: -

COURSE DESCRIPTION: Preamble and its Philosophy; Union Legislature; Federalism in India; Judiciary and Public Services; Nation Building

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

CO1. Gain knowledge in Parliamentary proceedings, Election Commission, Public Services and Foreign Policy of India.

CO2. Apply the reasoning informed by the various aspects in the Constitution, its provisions to assess societal issues and the consequent responsibilities relevant to the professional engineering practice.

DETAILED SYLLABUS:

UNIT I: PREAMBLE AND ITS PHILOSOPHY (8 Periods)

Introduction and Evolution of Indian Constitution, preamble and its philosophy

UNIT II: UNION LEGISLATURE (9 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 (9 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 (9 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 BOOK:

1. Mahendra Pal Singh,V. N. Shukla's, *Constitution of India*, Eastern Book Company, 2011. 2. Pandey J. N., Constitutional Law of India - Central Law Agency, 1998.

II B. Tech. - II Semester
(19BT40205) **RELIABILITY AND SAFETY ENGINEERING**
(Open Elective-1)
(Common to EEE, ECE and EIE)

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

PRE-REQUISITES: Courses on Differential Equations and Multi-Variable Calculus & Transformation Techniques and Linear Algebra.

COURSE DESCRIPTION: Fundamentals of reliability engineering; Network modeling and reliability evaluation; Markov chain and Markov processes; basics of safety concepts and safety techniques and applications.

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

CO1. Develop mathematical model of a network to evaluate the parameters for assessing the reliability of a system.

CO2. Analyze the time dependent/independent characteristics of a repairable system and frequency durations techniques to assess reliability.

CO3. Understand various safety management, policy, and planning strategies for personal and industrial safety.

CO4. Understand various safety and hazard identification techniques and follow appropriate safety measures in industry and society.

DETAILED SYLLABUS:

UNIT-I: FUNDAMENTALS OF RELIABILITY ENGINEERING (9 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 (9 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 (9 Periods)
Basic concepts, stochastic transitional Probability matrix, time dependent probability evaluation, Limiting State Probability, Absorbing states. Modeling 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 (9 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 (9 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 Billintonand 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 (8 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 POLLUTIONCONTROL (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 (8 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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, MiriliaBonnes, 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

PREREQUISITES: -

COURSE DESCRIPTION: Technology for rural development; Nonconventional energy; Technologies for rural development; Community development; IT in rural development.

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

CO1 Compare various technologies for rural development by solving rural problems through different schemes by considering ethics, society, environment and sustainability.

CO2 Analyze non-conventional energy sources using appropriate tools and techniques to solve rural energy problems considering society, environment and sustainability besides communicating effectively in graphical form.

CO3 Select appropriate technologies in different areas of rural development to solve rural issues following latest developments considering society, environment and sustainability.

CO4 Relate water conservation, health, safety and rural employment issues for community development to solve rural problems through appropriate technologies considering ethics, society, environment and sustainability.

CO5 Analyze the impact of IT, public and private partnership on rural development to solve complex rural problems using appropriate tools and techniques considering ethics, society, environment and sustainability.

DETAILED SYLLABUS:

UNIT – I: TECHNOLOGY FOR RURAL DEVLOPMENT (9 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 (9 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 (9 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 **(9 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 **(9 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. YadagiraCharyulu, *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, Foot printing, Social engineering, Port scanning, System hacking, Sniffers, Denial of service, Hacking web servers, Wireless hacking, Cryptography, Network Protection System.

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

CO1. Demonstrate knowledge on the computer security, social engineering and the intent of ethical hacking.

CO2. Select and apply foot printing and port scanning tools to discover vulnerabilities of the computer system.

CO3. Investigate hacking techniques and tools to maintain computer security.

CO4. Analyze cryptosystems and network protection systems for information security and intrusion prevention.

DETAILED SYLLABUS:

UNIT–I: ETHICAL HACKING, NETWORK AND COMPUTER ATTACKS (9 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 (9 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 (9 Periods)

Foot printing: Using web tools for foot printing, Conducting competitive intelligence, Using domain name system zone transfers.

Port Scanning: Port scanning, Using port scanning tools, Conducting ping sweeps, Understanding scripting.

UNIT-IV: SYSTEM HACKING (9 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 (9 Periods)

Cryptography: Understanding Cryptography basics, Symmetric and asymmetric algorithms, Public key infrastructure, Cryptography attacks.

Network Protection Systems: Understanding routers, Firewalls, Honey pots.

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 (8 Periods)

Introduction to AI in Healthcare, Benefits and Risks, AI in the health sector, AI versus Human Intelligence, The future of AI in health sector, AI and Neural networks.

UNIT-II:THE PRESENT STATE AND FUTURE OF AI IN HEALTHCARE SPECIALTIES (10 Periods)

Artificial Intelligence in: preventive healthcare, Radiology, Pathology, Surgery, Anesthesiology, Psychiatry, Cardiology, Pharmacy, Dermatology, Dentistry, Orthopedics, Ophthalmology.

UNIT –III: THE ROLE OF MAJOR CORPORATIONS IN AI IN HEALTHCARE (8 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 **(9 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.

EXT BOOKS:

1. Dr. Parag Mahajan, *Artificial Intelligence in Healthcare, Med Manthra Publications*, First Edition 2019.
2. *Arjun Panesar, Machine Learning and AI for Healthcare Big Data for Improved Health*, Apress Publications, 2019.

REFERENCE BOOKS:

1. Michael Matheny, 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, First Edition, 2019.

ADDITIONAL LEARNING RESOURCES:

1. https://www.udacity.com/course/ai-for-healthcare-nanodegree--nd320 (AI for Healthcare).
2. https://builtin.com/artificial-intelligence/artificial-intelligence-healthcare (Surgical robots, new medicines and better care: 32 examples of AI in healthcare).
3. https://healthtechmagazine.net/article/2020/02/future-artificial-intelligence-healthcare (Future of Artificial Intelligence in Healthcare).

II B. Tech. - II Semester
(19BT51506) BIOINFORMATICS
(Open Elective-1)
(Common to EEE, ECE and EIE)

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

PRE-REQUISITES: A course on Biology for Engineers.

COURSE DESCRIPTION: Biological Data Acquisition, Databases, Data Processing, Methods of Analysis, Applications of Bio-informatics.

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

CO1. Understand basic biological data acquisition in bioinformatics.
CO2. Identify the proper databases for the information search by choosing the biological databases and also submission and retrieval of data from databases.
CO3. Analyze the results of bioinformatics data using text and sequence-based searching techniques.
CO4. Analyze the secondary and tertiary structures of proteins by applying different alignment programs.
CO5. Design biological databases and novel drugs by using contextual knowledge on bioinformatics.

DETAILED SYLLABUS:

UNIT-I: BIOLOGICAL DATA ACQUISITION (9 Periods)
Biological information, Retrieval methods for DNA sequence, protein sequence and protein structure information

UNIT- II: DATABASES (9 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 (9 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 (9 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 **(9 Periods)**

Genome Annotation and Gene Prediction; ORF finding; Phylogenetic Analysis, Genomics, Proteomics, Genome analysis – Genome annotation, DNA Microarray, computer aided drug design (CADD).

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Lesk, A. K., "*Introduction to Bioinformatics"* 4th Edition, Oxford University Press, 2013
2. Dan Gusfield, *"Algorithms on Strings, Trees and Sequences: Computer Science and Computational Biology*" Cambridge University Press, 1997.

REFERENCE BOOKS:

1. Baldi, P. and Brunak, S., *"Bioinformatics: The Machine Learning Approach*" 2nd Edition, MIT Press. 2001
2. Mount, D.W., "*Bioinformatics Sequence and Genome Analysis*" 2nd Edition, Cold Spring Harbor Laboratory Press, 2004
3. Tindall, J., "*Beginning Perl for Bioinformatics: An introduction to Perl for Biologists"* 1st Edition, O'Reilly Media, 2001

II B. Tech. – II Semester
(19BT40231) **DIGITAL ELECTRONICS LAB**

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

PRE-REQUISITES: A course on Electronic devices and circuits.

COURSE DESCRIPTION: Practical investigations through simulation on logic gates; minimization of circuits; design of various combinational and sequential logic circuits.

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

CO1. perform various arithmetic operations on number systems and analyze simplification methods in logical circuits, to perform desired logical operations optimally using logical gates.
CO2. design combinational logical circuits for performing various arithmetic operations and data encoding and decoding for engineering applications.
CO3. analyze various sequential circuits for realizing counters and registers using flip-flops.
CO4. work independently or in teams to solve problems with effective communication.

Practical Exercises/List of Experiments:

Part-A: Analytical Exercises:
1. Number systems and their conversions.
2. Arithmetic operations on weighted non-weighted numbers.

Part-B: Any EIGHT experiments are to be conducted from the following
1. Verification of logic gates.
2. Minimization of logic circuits using K-Map.
3. Design of half adder & subtractor and full adder & subtractor.
4. Design of 4 bit comparator.
5. Design of 3 to 8 decoder & 8 to 3 encoder for an engineering application.
6. Design of 8 to 1 multiplexer.
7. Design of 4 bit
    a. binary adder and
    b. binary adder-subtractor
8. Design of 4 bit binary in crementer using 4 half adders.
9. Design of 4-bit combinational circuit shifter.
10. Design of BCD to seven segment decoder.
11. Design of 1 stage of logic circuit using logical gates and 4x1 multiplexer.
12. Design SR, JK, T and D Flip flops using logic gates.
13. Design a ring counter using flip flops.

TEXT BOOKS:

1. M. Morris Mano, *Digital Design*, Pearson education, 5^{th} Edition, 2013.

REFERENCE BOOKS

1. Anand Kumar, *Switching Theory and Logic Design*, PHI, 2008
2. ZviKohavi and NirahK.Jha, *Switching theory and Finite Automata Theory*, Tata McGraw-Hill, 2nd Edition, 1978

ADDITIONAL LEARNING RESOURCES:

1. http://cse15-iiith.vlabs.ac.in/
2. http://vlabs.iitb.ac.in/vlabs-dev/labs/dldgates/labs/index.php

II B.Tech. – II Semester
(19BT40232) ELECTRICAL ENGINEERING WORKSHOP

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

PRE-REQUISITES: Courses on Electric Circuits Lab and Electrical Machines-I Lab.

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. evaluate various electrical quantities using modern utilities, assess the functionality of various devices and analyze the practical observations for calibration.

CO2. design operating equipment for the various electrical appliances for sustainable operation, and estimate typical house wiring system following the code of conduct and realize the technological developments in design of operating equipment.

CO3. analyze various electrical appliances for troubleshooting and maintenance, and protection schemes for safety of personals and apparatus, and realize the technological developments in protection.

CO4. work independently or in teams to solve problems with effective communication.

List of Exercises/List of Experiments: Minimum **Ten** experiments are to be conducted.

1. Measurement of electrical quantities using MFM.
2. Operation and testing of Fuse, MCB and Relays.
3. Calibration of measuring instruments.
4. Practice bridges for measurement of circuit element parameters.
5. Design of starter for DC Motors.
6. Practicing and testing of DOL starter for Induction Motors.
7. Design of Timers for operation of electrical appliances.
8. Design and estimation of wiring for a typical house.
9. Troubleshooting of electrical appliances —Fan, Mixer/grinder, Water heater/Iron box.
10. Practicing plate and pipe earthing system.
11. Protection scheme for a 3-Phase Induction Motor. (Single Phasing, OL, Dry Run)
12. Installation and maintenance of UPS.

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

II B. Tech. – II Semester

(19BT40233) **ELECTRICAL MACHINES-II LAB**

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

PRE-REQUISITES: Courses on Electrical Machines-I and Electrical Machines-I Lab.

COURSE DESCRIPTION: Practical investigations on asynchronous and synchronous machines; Performance indices analysis, determination of equivalent circuit parameters and speed control methods of induction motor.

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

CO1. Analyze the performance of induction machines to evaluate operating parameters and interpret the practical observations for validation.

CO2. Analyze the performance of synchronous machines to evaluate operating parameters and interpret the practical observations for validation.

CO3. Analyze the performance of universal motor for various loading conditions.

CO4. Realize the philosophy of testing procedure of synchronous and asynchronous machines following the code of conduct.

CO5. 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. Brake test on three phase induction motor.
2. Separation of no-load losses of three phase induction motor
3. Speed control of induction motor
4. No load and blocked rotor test on three phase induction motor.
5. Regulation of a three phase alternator by E.M.F and M.M.F. methods.
6. Regulation of three phase alternator by Z.P.F. and A.S.A methods.
7. Efficiency of a three phase alternator.
8. Slip test on a salient pole synchronous machine.
9. V and inverted V curves of a three phase synchronous motor.
10. Equivalent circuit of single phase induction motor.
11. Brake test on universal motor.
12. Parallel operation of alternators.

TEXT BOOKS:

1. P.S. Bimbhra, *Electrical Machinery*, 7th Edition, Khanna Publishers, New Delhi, 2011.
2. JB Gupta, *Theory and performance of Electrical Machines (DC machines, Poly phase circuits & AC machines) in SI Units*, 15thEdition,S.K. Kataria& Sons, New Delhi, 2015.

REFERENCE BOOKS:

1. A.E. Fitzgerald, C.Kingsley and S.Umans, *Electric Machinery*, 6th Edition, McGraw-Hill, New Delhi, 2008.
2. B.L. Theraja and A.K. Theraja, *A Text Book of Electrical Technology in S. I. Units*, Vol.2, S.Chand Company Ltd, Multicolour Edition, New Delhi, 2014.

SOFTWARE/Tools used: Nil

ADDITIONAL LEARNING RESOURCES:

1. http://www.vlab.co.in/broad-area-electrical-engineering

II B. Tech. – II Semester
(19BT315AC) **DESIGN THINKING**
(Audit Course)
(Common to EEE, ECE and EIE)

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

PRE-REQUISITES: -

COURSE DESCRIPTION: Design thinking process, Design thinking phases, empathy tools; Idea generation, visualizing and empathizing; Fidelity for prototypes, prototyping; prototyping for physical products.

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

CO1. Analyze design thinking concepts and principles to perform human centered design process for creative problem solving.
CO2. Create empathy maps to visualize user attitudes and behavior for gaining insights of customers.
CO3. Develop innovative products or services for a customer base using ideation techniques.
CO4. Build prototypes for complex problems using gathered user requirements.
CO5. Apply design thinking tools techniques to produce good design and relevant products or services for a specific target market.
CO6. Improve prototype by testing it with a specific set of users for making it sustainable by following ethics.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO DESIGN THINKING (6 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 (6 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 (6 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 (6 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 **(6 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 Lesson Plan

TEXTBOOK:

1. S.Salivahanan, S.Suresh Kumar, D. Praveen Sam, "*Introduction to Design Thinking*" ,Tata McGraw Hill, First Edition,2019.
2. Kathryn McElroy, "*Prototyping for Designers: Developing the best Digital and Physical Products*", O'Reilly,2017.

REFERENCE BOOKS

1. Michael G. Luchs, Scott Swan , Abbie Griffin, "*Design Thinking – New Product Essentials from PDMA*", Wiley, 2015.
2. Vijay Kumar, "101 Design Methods: A Structured Approach for Driving Innovation in Your Organization", John Wiley & Sons, 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
(19BT40403) **LINEAR AND DIGITAL IC APPLICATIONS**

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

PRE-REQUISITES: Courses on Analog Electronics and Digital Electronics.

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 (9 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 (8 Periods)
Introduction, Language Elements, operators, Expressions, Modeling-gate level modeling, data flow modeling, behavioral modeling, structural modeling.

UNIT-IV: COMBINATIONAL LOGIC DESIGN APPLICATIONS (8 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 (9 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, 4thEdition, 2011.
2. John F. Wakerly, *Digital Design Principles & Practices*, Pearson Education Asia, 4thEdition, 2008.

REFERENCE BOOKS:

1. Ramakanth A. Gayakwad, *Op-Amps & Linear ICs*, PHI, 3rd Edition, 1998
2. J. Bhaskar, *A Verilog HDL Primer*, BS Publications, 2nd Edition, 2001

ADDITIONAL LEARNING RESOURCES:

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

III B. Tech. – I Semester
(19BT50201) CONTROL SYSTEMS

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

PRE-REQUISITES: A course on Signals & Networks.

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 mathematical model for various physical and electrical systems and determine the transfer function of the systems by applying the fundamental principles.

CO2. analyze the time response of first and second order system and 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 and for sustainable operation.

CO5. apply state space technique to model the system, and 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 (7 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 (8 Periods)

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

UNIT-V: STATE SPACE ANALYSIS (8 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, 5thEdition, 2010.

REFERENCE BOOKS:

1. Nagrath I.J. and Gopal M, *Control Systems Engineering*, New Age International Publications, 5thEdition, 2010.
2. Richard C. Dorf and Robert H. Bishop, *Modern Control Systems*, Prentice Hall, 12th Edition, 2010.
3. BenjaminC.Kuo and FaridGolnaraghi, *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

III B. Tech. – I Semester
(19BT50202) POWER SYSTEM OPERATION AND CONTROL

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

PRE-REQUISITES: Courses on Transmission & Distribution and Control Systems.

COURSE DESCRIPTION: Load forecasting; Optimal operation of generators in thermal power station; Optimal scheduling of hydrothermal system; Unit commitment; Modeling of Power system components; Reactive power and Voltage control; Load frequency control.

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

CO1. estimate the load profile using statistical methods for planning and scheduling of thermal plants in power system.

CO2. determine the optimal schedule of hydro-thermal plants for sustainable operation of the plant.

CO3. solve the unit-commitment problem using dynamic programming to allocate the load among the committed generators.

CO4. model the power system components appropriate for automatic generation control of power system.

CO5. assess the load frequency dynamics in single area and two-area system, and design a suitable controller to control the LFC dynamics.

DETAILED SYLLABUS:

UNIT-I: PLANNING AND ECONOMIC OPERATION OF THERMAL POWER SYSTEM (12 Periods)

Planning: Load curves, Load curve parameters – Connected load, Maximum Demand, Average Load, Load Factor, Demand Factor, Diversity Factor; Load forecasting: Simple regression – Linear and quadratic.

Economic Operation of thermal plants: Characteristics of thermal plants, cost function: fuel cost and incremental fuel cost; Optimum allocation with and without transmission losses, loss coefficients, general transmission line loss formula.

UNIT-II: HYDROTHERMAL SCHEDULING (08 Periods)

Introduction, classification of hydro plants, scheduling of hydro plants - long-term, short-term, scheduling energy. Hydrothermal scheduling - problem formulation, objective function, operational constraints. Short term scheduling - Lagrange function, penalty factor; iteration method.

UNIT-III: UNIT COMMITMENT (08 Periods)

Introduction, Constraints in unit commitment—Start-up and shutdown costs, up time and downtime, and reserves; Unit commitment solution methods - priority list method, dynamic Programming method (maximum of three plants for three operating hours only); Unit commitment Vs Economic dispatch.

UNIT-IV: MODELLING OF POWER SYSTEM COMPONENTS FOR AGC (07 Periods)
Load Frequency Problem; LFC Model - speed governor, turbine, generator-load model; Components and block diagram representation of IEEE type-1 excitation system; AVR model.

UNIT-V: LOAD FREQUENCY CONTROL IN POWER SYSTEM (10 Periods)
Load frequency control of single area system: Necessity of keeping frequency constant; Steady state response - uncontrolled and controlled case, dynamic response.
Load frequency control of two area system: Concept of control area, Block diagram representation, Steady state response - uncontrolled and controlled case, dynamic response, tie-line bias control.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. K. Uma Rao, *Power system operation and control*, Wiley India Pvt. Ltd, 1st Edition, 2013.
2. C. L. Wadhwa, *Electrical Power Systems*, New age International, New Delhi, 5th Edition, 2009.

REFERENCE BOOKS:

1. Sivanagaraju, S. *Power system operation and control*. Pearson Education India, 2009.
2. A. Chakravarthi and S. Halder, *Power System Analysis Operation and Control*, Prentice Hall India, 3rd Edition, 2006.

ADDITIONAL LEARNING RESOURCES

1. https://nptel.ac.in/courses/108/104/108104052/
2. https://www.digimat.in/nptel/courses/video/108105104/L53.html

III B. Tech. – I Semester

(19BT50203) **ELECTRICAL MACHINE DESIGN**

(Professional Elective-1)

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

PRE-REQUISITES: A course on Electrical Machines II.

COURSE DESCRIPTION: Electrical machine design concepts; Design of transformers, DC machines, Induction machines and alternators.

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

CO1. analyze the specific electrical and magnetic loading on various machines and determine the thermal aspects.

CO2. design the armature and field systems of DC motor and validate the performance of designed machine.

CO3. design the core, yoke, windings and cooling systems of a static device and determine its operational parameters.

CO4. design the stator and various types of rotors for induction motor and synchronous machines to validate the given specifications.

DETAILED SYLLABUS:

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

Major considerations in electrical machine design, classification of design problems, electrical engineering materials, space factor, choice of specific electrical and magnetic loadings; Thermal considerations, heat flow, temperature rise, rating of machines and standard specifications.

UNIT-II: DC MACHINES **(10 Periods)**

Output equation, main dimensions, magnetic circuit calculations, carter's coefficient, net length of iron, real & apparent flux densities, selection of number of poles, design of armature, design of commutator and brushes, Design of interpoles, performance prediction using design values.

UNIT-III: TRANSFORMERS **(09 Periods)**

Output equation, main dimensions for single and three phase transformers, Design of cores, window space factor, overall dimensions; Design of windings, estimation of no-load current, temperature rise in transformers, design of tank, methods of cooling of transformers.

UNIT-IV: INDUCTION MOTORS **(09 Periods)**

Output equation, choice of loadings, main dimensions, length of air gap, stator core and windings, rules for selecting rotor slots of squirrel cage machines; Design of rotor bars & slots, design of end rings, design of wound rotor; Dispersion coefficient.

UNIT-V: SYNCHRONOUS MACHINES **(08 Periods)**

Output equation, choice of loadings, design of salient pole machines, short circuit ratio (SCR), estimation of length of air gap using SCR, armature design, armature parameters, design of rotor, design of damper winding, determination of full load field mmf, design of field winding, design of turbo alternators.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. A.K. Sawhney, A. Chakrabarthi , *A Course in Electrical Machine Design*, 6th Edition,Dhanpat Rai & Co, Delhi, 2016.
2. M.V.Deshpande, *Design and Testing of Electrical Machines*, PHI learning Pvt. Ltd, New Delhi, 3rd Edition, May 2010.

REFERENCE BOOKS:

1. R.K. Agarwal, *Principles of Electrical Machine Design,* 5th Edition, S.K.Kataria & Sons, New Delhi, 2014
2. V.N.Mittle, Arvind Mittal, *Design of Electrical Machines,* 5th Edition, Standard publications, New Delhi, 2013
3. A.Nagoor Kani, A simplified text Electrical Machine Design, 2nd Edition, RBA Publications, Chennai, 2009.

ADDITIONAL LEARNING RESOURCES:

1. http://s3.mentor.com/mechanical/MagNet-BLDC-tutorial.pdf
2. https://www.mentor.com/products/mechanical/motorsolve/dcm/motor-analysis

III B. Tech. – I Semester
(19BT50204) **ENERGY SYSTEMS**
(Professional Elective-1)

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 conventional, 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 operational aspects of hydro, thermal and nuclear power plants and determine the efficiency of thermal power plant.

CO2. understand the generating principles and operational aspects of diverse peak load power plants and impact of conventional sources on environment.

CO3. understand the generating principles and operational aspects of solar, wind and geothermal generation technologies.

CO4. understand the generating principles and operational aspects of ocean, biomass and fuel cell power conversion technologies.

CO5. asses the energy harnessing methods and understand the principle of hybrid energy systems and energy storage systems for sustainability.

DETAILED SYLLABUS:

UNIT-I: CONVENTIONAL ENERGY SOURCES-1 (07 Periods)

***Hydro and Thermal power plants*:** Selection of site for hydro and thermal power plants; Concept of pumped storage plants; Efficiency of a thermal power plant.

Nuclear power stations: Introduction, site selection, working and operation of nuclear power station, classification nuclear reactors— PWR, BWR, Breader reactors and merits & demerits.

UNIT-II: CONVENTIONAL ENERGY SOURCES-2 (09 Periods)

Diesel engine power plant: Introduction, working and operation of diesel power plant with layout; Applications.

Gas turbine power plant: Introduction, working and operation of gas turbine power plant; Applications.

Environmental aspects of electric power generation from conventional sources: Limitation of fossil fuels - effects of hydro-electric projects; GHG emission from various energy sources and its effects— Atmospheric pollution; disposal of nuclear waste; Need for renewable energy sources.

UNIT-III: RENEWABLE ENERGY SOURCES-1 (12 Periods)

***Solar energy* —**Introduction, solar radiation, measurement of solar radiation—pyranometers; PV cell— types, configuration of solar panel; Mathematical modeling of PV cell, I-V and P-V curves, Block diagram approach of solar PV system.

Wind Energy- Introduction, power extraction form the wind, Wind turbines— propeller type horizontal axis and vertical axis-darrieus rotor wind turbines; Basic components of wind energy conversion systems; Environmental impacts.
Geothermal energy*:* Introduction, Geothermal resources, geothermal power plants—vapor dominated and liquid dominated; environmental issues.

UNIT-IV: RENEWABLE ENERGY SOURCES-2 (10 Periods)
Energy from ocean: Introduction, ocean thermal energy conversion (OTEC): Open and closed cycle systems power plants; tidal energy: schematic diagram of tidal power plant and its classification-single basin and double basin arrangements.
Energy from Biomass: Introduction, biomass conversion technologies-direct, thermochemical and biochemical conversions; biogas generation.
Fuel cell: Fuel cells-working, classification.

UNIT-V: COGENERATION AND HYBRID ENERGY SYSTEMS (07 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, Battries.

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. R. K. Rajput, *A textbook of power system engineering*, Laxmi publications (P) Ltd, 2016.

REFERENCE BOOKS:

1. C.L. Wadhwa, *Generation Distribution and Utilisation of Electrical Energy*, New Age, International publishers, 3rd Edition, 2015.
2. J K Kaldellis, *Stand-alone and Hybrid Wind Energy Systems*, Wood head, publishing ,1st Edition 2010.
3. David Flin, Cogeneration: *A User's Guide. Renewable energy series*, Vol. 11. IET, 2010.
4. *S.Rao, Dr.B.B.Parulekar, Energy Technology,* third Edition, Khanna publications, 2013.
5. D P Kothari, K C Singal and Rakesh Ranjan, '*Renewable Energy Sources and Emerging Technologies*' 2nd Edition, 2012.

III B. Tech. – I Semester

(19BT50205) **ENERGY AUDIT, CONSERVATION AND MANAGEMENT**

Professional Elective-1

(Common to CE and EEE)

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

PRE-REQUISITES: A course on Basic Electrical and Electronic Engineering.

COURSE DESCRIPTION: Principles of energy audit, management and conservation; Energy efficient motors, lighting schemes; Energy measuring instruments and significance of energy economics.

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

CO1. apply the relevant rules, regulations and procedures 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 propose appropriate illumination system by applying the protocols of energy auditing.

CO3. apply appropriate energy auditing instruments for energy auditing in industries and assess the economic benefits of auditing.

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 audit in industries, energy saving potential, energy audit of process industry, thermal power station, building energy audit, case study. 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, current energy consumption in India, roles and responsibilities of energy managersin 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, motor energy audit.

Lighting—Good lighting system design and practice, lighting control, lighting energy audit.

UNIT-IV: ENERGY INSTRUMENTS AND ECONOMIC ANALYSIS (09 Periods)

Energy Instruments— Infrared thermometer, data loggers, thermo-couples, pyrometers, Lux meters, tongue testers, power quality analyzer, and PLC and pic applications.

Energy Economic Analysis— The time value of money concept. Cash flow models, payback analysis, depreciation, taxes and tax credit - numerical problems.

UNIT-V: DEMAND SIDE MANAGEMENT (09 Periods)

Introduction to DSM, concept of DSM, benefits of DSM, different techniques of DSM – time of day pricing, multi-utility power exchange model, and time of day models for planning, load management, load priority technique; 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. – I Semester
(19BT50206) **INSTRUMENTATION**
(Professional Elective-1)

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

PRE-REQUISITES: Courses on Analog Electronic Circuits and Electrical Measurements.

COURSE DESCRIPTION: Principle of operation, advantages and limitations of various types of electronic and digital instruments for measurement of electrical quantities; Signal Analyzers, Data acquisition, display devices and recorders.

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

- CO1. understand the construction and working principle of various electronic instruments and apply them to measure various electrical parameters.
- CO2. apply various transducers for the measurement of various non-electrical quantities.
- CO3. understand the principle of operation of various spectral analysers and their applications for various signals.
- CO4. understand the principle of data acquisition systems and apply these principles for recording/storing the data.
- CO5. apply monitoring instruments for recording various electrical and non-electrical quantities and determine the required precision.

DETAILED SYLLABUS:

UNIT – I: ELECTRONIC INSTRUMENTS (10 Periods)
Electronic voltmeter using rectifiers; AC voltmeter — Average, Peak and true RMS voltmeters; Vector impedance meter, Vector voltmeter, Digital phase meter, Capacitance meter, Digital LCR meter; Q meter— measurement of low, high impedance, band width and errors.

UNIT – II: NON-ELECTRIC QUANTITIES MEASUREMENT (9 Periods)
Measurement of Torque — Torque transducers, Inductive torque transducer and Digital methods. Measurement of Low Pressure — Thermocouple vacuum gauge and Pirani Gauges.
Measurement of Flow — Turbine meters, Hotwire Anemometers and Electromagnetic flow transducer.

UNIT – III: SIGNAL ANALYZERS (10 Periods)
Analyzers — Resonant wave analyzer, Frequency selective analyzer, Heterodyne analyzer, Harmonic distortion analyzer, Total Harmonic distortion analyzer, logic analyzer and Power analyzer; Application of wave analyzer; Spectrum analyzer — basic spectrum analyzer, spectra of different signals.

UNIT – IV: DATA ACQUISITION SYSTEMS (09 Periods)
Generalized data acquisition system and its components, Types of multiplexing systems — time division and frequency division multiplexing; Digital data acquisition system, use

of data acquisition systems and recorders in digital systems; Digital recording systems — block diagram and its working; Modern digital DAS — Analog multiplexer operation and operation of Sample-Hold circuits.

UNIT – V: DISPLAY DEVICES AND RECORDERS (07 Periods)

Display devices — LED, LCD, LVD and VDU; Recorders — graphic, ultraviolet, magnetic tape recorders, digital tape recorders, biomedical recorders.

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 & Instrumentation*, DhanpatRai and Co. Publishers,19th Edition, 2015.
2. J.B. Gupta, A course in *Electrical and Electronics Measurements & Instrumentation*, S.K. Kataria publishers, 14th Edition, 2015.

REFERENCE BOOKS:

1. H. S. Kalsi, *Electronic Instrumentation*-by Tata MC Graw Hill Company, 3rd Edition, 2010.
2. D.V.S Murthy, *Transducers and Instrumentation*, Prentice Hall of India, New Delhi, 2nd Edition, 2010.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/105/108105064/
2. https://nptel.ac.in/courses/108/105/108105153/

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 (9 Periods)
Meaning - Importance of banking - Functions of banking - **Reserve Bank of India**: Functions – Role of RBI in sustainable development.

UNIT- II: BANK-CUSTOMER RELATIONSHIP (9 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 (9 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 (9 Periods)
Concept of risk, risk *Vs* uncertainty. **Insurance**: Definition, Insurance as risk mitigation mechanism, elements of insurance.

UNIT- V: INSURANCE OVERVIEW (9 Periods)
Principles and Functions of Insurance - Types of Insurance - LIC and GIC - IRDA - Insurance Players in India.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. RanganadhaChary,A.V. and Paul, R.R., *Banking and Financial system*, Kalyani Publisher, New Delhi, 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 (9 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 (9 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 (9 Periods)

Introduction to Standard Costing & Variances – Variance Analysis: Material variances, Labour variances (Simple Problems).

UNIT- IV: FINANCIAL MANAGEMENT& RATIO ANALYSIS (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (6 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 (9 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 (9 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 (9 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 (9 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 (9 Periods)

Business presentations and speeches, structuring the material, Types of delivery, Guidelines for delivery, Effective sales presentation, Controlling nervousness and stage fright.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Dr. K. Alex (2018) *Soft Skills*, S. Chand and Company Limited, New Delhi.
2. Manmohan Joshi (2017) *Soft Skills*, bookboon.com, Bangalore.

REFERENCE BOOKS:

1. Meenakshi Raman and Prakash Singh (2013), *Business Communication*, Oxford University Press, New Delhi.
2. Jeff Butterfield (2011) *Soft Skills for Everyone*, Cengage Learning India Private Limited, Delhi.

III B. Tech. – I Semester
(19BT4HS11) PROFESSIONAL ETHICS
Open Elective-2
(Common to EEE, ECE and EIE)

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

PRE-REQUISITES: --

COURSE DESCRIPTION: Engineering Ethics; Professional Ideals and Virtues; Engineering as Social Experimentation; Responsibilities and Rights; Global Issues.

COURSE OUTCOMES: After successful completion of this course, the students will be able to*:*
CO1. Demonstrate knowledge in Engineering Ethics, Responsibilities and Rights.
CO2. Analyze the concepts of Engineering in Social Experimentation and Global Issues.
CO3. Apply the nuances of professional ideals at work place and in social context.

DETAILED SYLLABUS:

UNIT –I: ENGINEERING ETHICS (9 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 (8 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (8 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 (8 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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 (9 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

PRE-REQUISITES: --

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 (9 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 (9 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 (9 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 (9 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 (9 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, 2nd 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 (8 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 **(8 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 **(9 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 (9 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 (9 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 (9 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 (9 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 (9 Periods)

Cybercrimes: What is cybercrime, Categories, Different kinds of cybercrime, Cybercrimes and Information Technology Act, 2000 - Territorial scope and applicability, India's national cyber security policy.

Protecting Privacy on the Internet: Meaning of privacy, Threat to privacy on the Internet, Use of cookies and web bugs, Terms of use and privacy policy, Government right to interception, Employee privacy rights, Indian legal framework for data protection and privacy, Challenges to right of privacy in India.

Total Periods: 45

Topics for self-study are provided in the lesson plan

TEXT BOOK(S):

1. Karnika Seth, *Computers Internet and New technology Laws*, LexisNexis, 2013.

REFERENCE BOOKS:

1. Sarika Gupta, Gaurav Gupta, *Information Security and Cyber Laws*, Khanna Publishing, 2019.
2. Vivek Sood, *Cyber Law Simplified*, McGraw Hill,2018.
3. Pavan Duggal, *Textbook on Cyber Law*, Universal LexisNexis, 2019.

ADDITIONAL LEARNING RESOURCES:

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: TRADE MARKS (8 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 (9 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: TRADE SECRETS (9 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 (9 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 (9 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 (9 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 **(9 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 **(9 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 **(9 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

(19BT50442) PRINCIPLES OF COMMUNICATIONS

(Inter disciplinary elective-1)

(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 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 Edition, 2007.

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
(19BT51041) **PLC AND SCADA**
(Inter disciplinary elective-1)

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

PRE-REQUISITES: A course on Digital Electronics.

COURSE DESCRIPTION: Introduction to PLC, PLC ladder diagrams, programming on PLC, timers, counters and sequences used in PLC, Display Conventions and Navigation, Remote Terminal Units, Master Terminal Units, SCADA Works Station Application Programmes.

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

CO1. Demonstrate knowledge on programmable logic controllers and various functions of PLCs.
CO2. Develop PLC program, to solve various problems in process industries.
CO3. Demonstrate knowledge on various elements of SCADA Software.
CO4. Analyse the industrial process by using various displays in SCADA software and provide appropriate solutions.

DETAILED SYLLABUS:

UNIT-I: PLC BASICS AND PROGRAMMING (10 Periods)
Introduction, PLC system, CPU, I/O modules and interfacing, power supplies, Programming equipment, Programming formats, Construction of PLC ladder diagrams, Devices connected to I/O modules. Input instructions, Outputs, Operational procedures.

UNIT-II: LADDER DIAGRAMS, REGISTERS AND TIMER FUNCTIONS (10 Periods)
Digital logic gates, Boolean algebra PLC programming, Fail-Safe Circuits, characteristics of Registers, module addressing, holding registers, Input Registers, Output Registers. Timer function, Counter function & industrial applications.

UNIT-III: INTERMEDIATE AND DATA HANDLING FUNCTION (9 Periods)
Intermediate functions: Arithmetic functions, Number comparison functions, Number conversion functions. Skip, Master control relay, Jump functions, Sequencer functions and applications, Controlling of two-axis & three axis Robots with PLC, Matrix functions.

UNIT- IV: THE ELEMENTS OF SCADA SOFTWARE (10 Periods)
SCADA System Architecture - Field Devices and Signals, Programmable Process Controller, Communication Network, Central Control Facilities, Display Conventions and Navigation. Remote Terminal Units-Discrete control, analog control, Monitor discrete signals, monitor analog signals. Master terminal Units.

UNIT-V: SCADA WORKS STATION APPLICATION PROGRAMME (6 Periods)
Identifying the process areas, configuring HMI applications. Process Graphic Displays-Current Process Operations, Equipment Control Displays, Alarm and Event Summaries,

Trends and Historical Reports, Maintenance Displays. Configuration of I/O Server, System graphic displays Sample Application: Water Treatment Plant SCADA System.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXT BOOK:

1. John W. Webb & Ronald A. Reiss, *Programmable Logic Controllers Principles and Applications*, 5th Edition, PHI, 2009.
2. Stuart G. Mc. Crady, *Designing SCADA Application Software A Practical Approach*, 1st Elsevier, 2013.

REFERENCE BOOK:

1. Frank D. Petruzella, *Programmable Logic Controller*, 3rd Edition, Tata McGraw-Hill Edition 2010.
2. Stuart A. Boyer, *Supervisory Control and Data Acquisition*, 3rd Edition, ISA 2004.

WEBLINKS:

1. https://openautomationsoftware.com/use-cases/allen-bradley-wpf-scada/
2. https://new.siemens.com/global/en/products/automation/industry-software/automation-software/scada.html
3. https://ab.rockwellautomation.com/Programmable-Controllers
4. https://en.wikipedia.org/wiki/SCADA
5. http://www.isa.org
6. http://www.controleng.com
7. http://literature.rockwellautomation.com
8. http://www.automation.siemens.com

III B.Tech. I Semester
(19BT51042) SENSORS AND SIGNAL CONDITIONING
(Inter disciplinary elective-1)

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

PRE-REQUISITES: A course on Electrical Measurements.

Course Description: Principle of operation, construction, advantages, limitations and applications of resistive, inductive, capacitive, self-generating, digital and other sensors. Signal conditioning circuits and their operations.

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

- CO1. Identify and apply suitable passive sensor to measure physical parameters such as displacement, temperature based on principle and characteristics.
- CO2. Identify and apply suitable self-generating sensor to measure physical parameters based in principle of operation.
- CO3. Identify and apply suitable digital sensor to measure physical parameters based on principle of operation.
- CO4. Design signal conditioning circuit for various sensors based on applications.

DETAILED SYLLABUS:

UNIT – I: RESISTIVE SENSORS (09 Periods)
Principle of transducers, classification, Factors influencing the choice of transducers. Potentiometers, Metal and semiconductor strain gauges— principle of operation, gauge factor, gauge sensitivity; Resistance temperature detectors, Thermistors, Light dependent resistors, resistive hygrometer.

UNIT – II: CAPACITIVE AND INDUCTIVE SENSORS (09 Periods)
Capacitive sensors— Variation in overlapping area, variation in dielectric constant, variation in distance between the plates of variable and differential capacitor, Frequency response of capacitive sensors.
Inductive sensors— Variable reluctance sensors, Eddy current sensors, Linear variable differential transformers, Synchro’s, Resolvers, Electromagnetic sensors based on Faraday’s law, Hall effect sensors.

UNIT – III: SELF-GENERATING SENSORS (09 Periods)
Thermoelectric sensors— Thermoelectric effects, Thermocouple laws, Cold junction compensation, common thermocouples. Piezoelectric sensors— Piezoelectric effect, deformation modes, equivalent circuit, materials. Pyroelectric Sensors— Pyroelectric effect, materials; Photoelectric sensors— photovoltaic effect, materials; Magnetostrictive sensors.

UNIT – IV: DIGITAL AND OTHER SENSORS (09 Periods)
Digital transducers: Tachometer encoder, incremental encoder, absolute encoder. Semiconductor sensors — principle of operation and techniques; Fiber optic sensors—

principle of operation, sensor technology; Ultrasonic sensors— principle of operation, sensing methods; Basics of SMART sensors.

UNIT – V: SIGNAL CONDITIONING (09 Periods)
Block diagram of signal conditioning, balance and deflection measurement in Wheatstone bridge, measurement of reactance; Push-pull bridge and Blumein bridge; Carrier amplifier, chopper amplifier, low drift amplifier and charge amplifier, Instrumentation amplifier.

Total: 45 Periods

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Ramon Pallas-Areny and John G. Webster, *Sensors and Signal Conditioning*, John Wiley & Sons, Inc., 2nd Edition, 2001.
2. A.K.Sawhney, *A Course in Electrical and Electronic Measurements and Instrumentation*, Dhanpat Rai & Co., 19th Edition, 2015.

REFERENCE BOOKS:

1. D. V. S Murty, *Transducers and Instrumentation*, PHI Learning Private Limited, 2nd Edition, 2010.
2. D. Patranabis, *Sensors and Transducers*, PHI Learning Private Limited, 2nd Edition, 2003.
3. John P. Bentley, *Principles of Measurement Systems*, Pearson Education, 4th Edition, 2005.
4. Ernest O. Doebelin, Dhanesh N Manik, *Measurement Systems,* 6th Edition, 2011.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/108/108108147/
2. https://nptel.ac.in/courses/112/103/112103174/

III B. Tech. – I Semester

(19BT50207) COMPUTER ORGANIZATION AND ARCHITECTURE

(Inter Disciplinary 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 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, the students 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 (7 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 (8 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
(9 Periods)

Microprogrammed Control: Control memory, address sequencing, Microprogram Example, design of control unit; Pipelining: Basic concepts, Data Hazards, Instruction Hazards, Out of order execution.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. M. Moris Mano, *Computer System Architecture*, Pearson/PHI, 3rd Edition, 2008.
2. Ramesh S Gaonkar, *Microprocessor - Architecture, Programming and Applications with the 8085*, Penram International Publishing Private Limited, 5th Edition, 2007.

REFERENCE BOOKS:

1. Carl Hamacher, ZvonksVranesic, SafeaZaky, *Computer Organization*, Mc Graw Hill, 5th Edition, 2002.
2. William Stallings, *Computer Organization and Architecture*, Pearson/PHI, 6th Edition, 2003.

ADDITIONAL LEARNING RESOURCES:

1. NPTEL_CAO: https://nptel.ac.in/courses/106/105/106105163/.
2. Coursera: https://www.coursera.org/learn/comparch
3. EDX : https://www.edx.org/learn/computer-architecture

III B. Tech. – I Semester

(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 Node MCU 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.

III B. Tech. – I Semester
(19BT40433) **LINEAR AND DIGITAL IC APPLICATIONS LAB**

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

PRE-REQUISITES: A course on Digital Electronics.

COURSE DESCRIPTION: Design, simulation 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 and simulate various op-amp applications and timers' circuits using any analog simulation tool 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: (Minimum **Five experiments** to be to be conducted using **hardware)**

1. Design and Simulate RC Phase shift oscillator circuit using Op-Amp 741.
2. Design and Simulate an Instrumentation Amplifier using Op-Amp 741 with required gain.
3. Design and Simulate applications of 555 timer (Monostable/Astable Multivibrator) with given duty cycle and frequency.
4. Design and Simulate an Active first and second order LPF/HPF filter for a given cut off frequency using Op-amp 741.
5. Design and Simulate D-A converter (R-2R ladder) using Op-amp 741 with required voltage levels.
6. Design and verify an Active first and second order LPF/HPF filter for a given cut off frequency using Op-amp 741.
7. Design and verify applications of 555 timer (Monostable/Astable Multivibrator) with given duty cycle and frequency.

PART B: (Minimum **FIVE experiments** to be conducted using **Verilog HDL**)

8. Arithmetic and Logic Unit using IC 74x181.
9. Barrel Shifter using 74x151 multiplexer.
10. Floating Point Encoder.
11. Dual Priority Encoder.
12. Self-Correcting Ring Counter.

13. Universal Shift Register using IC 74x194.
14. 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:

. Multisim tool (multisim live)
. XILINX tool

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

III B. Tech. – I Semester
(19BT50231) **SOCIALLY RELEVANT PROJECT-I**

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

PRE-REQUISITES: -

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. – 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 (6 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 (6 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 (6 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 (6 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 (6 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, 8th Edition, 2013.
2. Marc J Dollinger, Entrepreneurship: Strategies and Resources, Pearson, 3rd 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 (9 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 (9 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 (9 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 (9 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 (9 Periods)

Introduction to Final Accounts - Trading account - Profit and Loss account and Balance Sheet with simple adjustments (Simple problems)

Tally ERP 9.0: Introduction – Create a company – Create ledger – Posting vouchers – Advantages of Tally.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. H L Ahuja, *Business Economics (13th Edition)*, S Chand Publishing, Jan 2016.
2. S.P. Jain and K.L. Narang, *Financial Accounting*, Kalyani Publishers, Ludhiana, 12th Edition, 2018.

REFERENCE BOOKS:

1. Joseph G.Nellis and David Parker, Principles of Business Economics, Pearson Education Canada, 2nd Edition, 2016.
2. Larry M. Walther, Financial Accounting, Create Space Independent Publishing Platform, July 2017.

III B. Tech. – II Semester
(19BT60201) **POWER ELECTRONICS**
(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.

COURSE DESCRIPTION: Power semiconductor devices; Silicon Controlled Rectifier — Turn-on methods, Triggering and commutation circuits for SCR; Single phase and three phase controlled rectifiers; Choppers; AC voltage controllers and Cyclo-converters; Inverters.

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

CO1. understand the switching operations/characteristics of uncontrolled, semi-controlled and fully controlled power semiconductor devices.

CO2. analyze commutation circuits, buck and boost operations of DC-DC converters circuit for different duty cycles.

CO3. analyze AC-DC, AC-AC and dual converters circuit operation and evaluate their output parameters for R & RL loads with different firing pulses.

CO4. analyze the conduction modes and PWM techniques of DC-AC converters circuit by single phase or three phase topologies.

DETAILED SYLLABUS:

UNIT-I: POWER SEMICONDUCTOR DEVICES (11 Periods)
Introduction to power electronics, Power diode — switching characteristics. Power transistors — power BJT, power MOSFET, IGBT and their characteristics; Thyristor — basic theory and operation, static and dynamic characteristics; two transistor analogy, turn-on methods, UJT firing circuits, series and parallel operation; protection against dv/dt and di/dt, design of snubber circuit.

UNIT-II: PHASE CONTROLLED RECTIFIERS (11 Periods)
Single phase controlled rectifiers — half wave controlled rectifier, bridge connections semi and fully controlled rectifiers with R and RL loads, derivation of average load voltage and current, effect of freewheeling diode; effect of source inductance; Three phase controlled rectifiers — half and fully controlled rectifiers-midpoint connection with R load, Bridge connections with R and RL loads, derivation of average load voltage and current.

UNIT-III: COMMUTATION CIRCUITS AND CHOPPERS (07 Periods)
Thyristor forced commutation circuits; Chopper — step-down and step-up operation, control strategies, derivation of load voltage with R load. Load commutated chopper.

UNIT-IV: DUAL CONVERTERS & AC VOLTAGE CONTROLLERS (07 Periods)
Dual converters — circulating and non-circulating current modes of operation of single phase and three phase dual converters with R-Load; Single phase AC voltage controllers

— two SCRs in anti-parallel with R and RL loads, derivation of RMS load voltage and load current; Cyclo-converters — single phase midpoint and bridge type (step-up and step-down operations) with R and RL loads.

UNIT-V: INVERTERS **(09 Periods)**

Single phase inverters — basic operation, voltage source inverters, current source inverter and basic series & parallel inverters. Voltage control by pulse width modulation techniques — single pulse, multiple pulse and sinusoidal PWM techniques; Three phase bridge Inverters — 180^0 and 120^0 conduction modes of operation.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Dr. P. S. Bimbhra, *Power Electronics*, Khanna Publishers, 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
(19BT60202) POWER SYSTEM ANALYSIS

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

PRE-REQUISITES: A course on Power System Operation and Control.

COURSE DESCRIPTION: Per Unit analysis; Formulation of network matrices; Computation of power flow using various iterative techniques; Symmetrical components and Sequence Networks; Analysis of various balanced and unbalanced faults, and stability analysis of power system.

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

CO1. apply the concepts of per-unit system to represent the power system network, and algorithms to model the power system network in terms of bus matrices.
CO2. analyze the power system network to investigate the power flow in various lines of a power system network using numerical methods.
CO3. analyze the power system networks to determine the fault level for various faults in a power system and prefer the current limiter reactors to sustain circuit breakers.
CO4. investigate stability of a power system network under various operating conditions using conventional and numerical methods to sustain stability.

DETAILED SYLLABUS:

UNIT-I: PER UNIT REPRESENTATION AND NETWORK MATRICES (08 Periods)
Per unit **—** advantages, change of base, per unit equivalent reactance representation of power system networks; Construction of Y-bus using inspection methods; Formation of Z_{Bus} using Z_{Bus} building algorithm — Modification of Z_{Bus} due to change in network impedance (without mutual coupling).

UNIT-II: POWERFLOW STUDIES (12 Periods)
Necessary and importance of power flow; Static load flow equations — Formulation of power flow problem— Iterative solution using Gauss-Seidel, Newton-Raphson method (polar coordinates only), Decoupled method and Fast Decoupled methods (with and without PV and for a maximum 3 bus system only); Algorithm; Comparison of different load flow methods.

UNIT-III: BALANCED FAULT ANALYSIS (06 Periods)
Three phase short circuit on unloaded synchronous generator; Effect of Load Current or Pre-fault Current — analysis using Thevenin's theorem and bus impedance matrix; Short circuit capacity; Current limiting reactors.

UNIT-IV: UNBALANCED FAULT ANALYSIS (09 Periods)
Symmetrical component theory — Sequence voltages, currents, impedances; Sequence representation of power system components — Sequence networks; Importance of short

circuit analysis; Unsymmetrical faults—LG, LL, LLG on an un-loaded generator and power system networks.

UNIT-V: POWER SYSTEM STABILITY (10 Periods)
Basic concepts, definitions and classification; Steady state stability — power limit and transfer reactance; Swing equation; Equal area criterion, Applications — Determination of critical clearing angle and time; Solution of swing equation — Point-by-point method; Methods to improve transient and steady state stability.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. C. L. Wadhwa, *Electrical Power systems*, 7th Edition, New Age International (P) Limited, Publishers, New Delhi, 2017.
2. Hadi Saadat, *Power System Analysis*, Tata McGraw Hill Education Pvt. Ltd., New Delhi, 21st reprint, 2010.

REFERENCE BOOKS:

1. John J. Grainger and William D. Stevenson, Jr., *Power System Analysis*, McGraw-Hill, 2003.
2. T.K.Nagsarkar and M.S.Sukhija, *Power System Analysis*, Oxford University Press, New Delhi, 2007.
3. K. Uma Rao, *Computer Techniques and Models in Power Systems*, I.K. International Publishing House Pvt. Ltd., 2010.

ADDITIONAL LEARNING RESOURCES:

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

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 Liapunov 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 (7 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 **(7 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 and variable gradient methods.

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
(19BT60204) **HIGH VOLTAGE ENGINEERING**
(Professional Elective-2)

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

PRE-REQUISITES: Courses on Electromagnetic fields and Electrical circuits.

COURSE DESCRIPTION:
Electrostatic fields; Breakdown phenomena of insulation; Generation of high voltages; Measurement of HV and Testing of high voltage apparatus.

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

- CO1. analyze the behaviour of dielectrics in the presence of high voltages using the principles of electric fields.
- CO2. analyze the generating circuits for generation of high voltages and currents.
- CO3. analyze the measuring circuits and techniques for the measurement of high Voltages and currents.
- CO4. realize the philosophy of sustainable testing and develop procedures for testing of various high voltage equipment by adhering relevant standards.

DETAILED SYLLABUS:

UNIT-I: ELECTROSTATIC FIELDS (6 Periods)
Introduction to high voltage engineering — electrical field distribution; breakdown strength of insulating materials; field distortions by conducting particles; fields in multi-dielectric materials.
Over voltages — causes and protection against over voltages.

UNIT-II: BREAKDOWN PHENOMENA (11 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-III: GENERATION OF HVAC, HVDC, IMPULSE VOLTAGE AND CURRENT (12 Periods)
Generation of HVAC and HVDC — cascade connection of transformers; series resonant circuit; tesla coil; voltage doubler circuit; Cock Croft Walton circuit — calculation of regulation, ripple and optimum number of stages for minimum voltage drop.
Generation of impulse voltage and current — introduction to standard lightning and switching impulse voltages; analysis of single stage impulse generator — expression for output impulse voltage; multi stage impulse generator — working principle, rating and

components of impulse generator; triggering of impulse generator; generation of high impulse current.

UNIT-IV: MEASUREMENT OF HIGH VOLTAGE AND CURRENT (8 Periods)
HVAC measurement — Chubb and Fortescue method; HVDC measurements — generating voltmeter principle, construction; potential dividers — resistance dividers, capacitance dividers, mixed RC potential dividers; Standard sphere gap measurements of HVAC, HVDC and impulse voltages; factors affecting the measurements; Measurement of high impulse currents — Rogowsky coil and magnetic links.

UNIT-V: TESTING OF HIGH VOLTAGE APPARATUS (8 Periods)
Non-destructive testing — measurement of DC resistivity — Galvanometer method, loss of charge method; Dielectric loss and loss angle measurements using Schering bridge; Partial discharge measurements – straight discharge detection circuit.
Testing of high voltage apparatus — testing of insulators, bushings, power transformers, cables, surge arresters and circuit breaker.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. E. Kuffel, W.S. Zaengl and J. Kuffel, *High Voltage Engineering: Fundamentals*, 2nd Edition, Newnes, Elsevier Press, 2000.
2. M. S. Naidu and V. Kamaraju, *High Voltage Engineering*, 4th Edition, Tata McGraw-Hill Publishing Company Ltd., New Delhi, 2008.

REFERENCE BOOKS:

1. C.L. Wadhwa, *High Voltage Engineering*, 3rd revised Edition New Age Science, 2010.
2. Mazen Abdel-Salam, Hussein Anis, Ahdab El-Morshedy, Roshdy Radwan, *High Voltage Engineering Theory and Practice*, 2nd Edition, Revised & Expanded, Marcel-Dekker Publishers (Special Indian Edn.), 2000.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/104/108104048/#
2. http://vlabs.iitkgp.ernet.in/vhv/

III B. Tech. – II Semester
(19BT60205) **SPECIAL ELECTRICAL MACHINES**
(Professional Elective – 2)

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

PRE-REQUISITES: Courses on Electrical Machines – II and Power Electronics.

COURSE DESCRIPTION: Construction, Working, Types, control operation, characteristics and applications of Stepper Motors, Switched Reluctance Motors, Synchronous Reluctance Motors, Permanent Magnet 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 (8 Periods)
Types of construction and working principle of stepping motor. Various configurations for switching the phase windings, torque equation and characteristics. Open loop and closed loop control of stepper motor, applications.

UNIT-II: SWITCHED RELUCTANCE MOTORS (9 Periods)
Construction details, Principle of operation – Design of stator and rotor pole arcs – torque equation and characteristics, power converter for switched reluctance motor, control of switched reluctance motor, rotor position sensing mechanism.

UNIT-III: SYNCHRONOUS RELUCTANCE MOTORS (8 Periods)
Constructional features, Types – Axial and Radial flux motors. Principle of operation, torque-speed characteristics, Phasor diagram, Characteristics, control of SyRM, advantages and applications.

UNIT-IV: PERMANENT MAGNET MOTORS (12 Periods)
Permanent magnet materials–hysteresis loop, analysis of magnetic circuits.

Permanent Magnet DC Motors (PMDCM): Constructional details, principle of operation, types of BLDC motor, sensorless and sensor based control of BLDC motors, Torque/speed characteristics and Applications.
Permanent Magnet AC Motors (PMACM): Principle of operation - Ideal PMSM– EMF and Torque – Synchronous Reactance – Sine wave motor with practical windings - Torque/speed characteristics – Applications.

UNIT-V: AC SERIES AND LINEAR MOTORS (8 Periods)
AC Series Motors: Construction, principle, characteristics and applications
Linear Induction Motor(LIM): Construction, principle of operation– single sided and double-sided LIM, thrust equations and performance equations based on current sheet concept, equivalent circuit of LIM, applications.
Linear Synchronous Motor (LSM): Construction, types, principle of operation, thrust equation, control 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. Kenjo and S. Nagamori, *Permanent-Magnet and Brushless DC Motors*, clarenden press, Oxford, 1984.
3. T.J.E. Miller, *Brushless Permanent Magnet and Reluctance Motor Drives*, clarenden press, Oxford 1989.
4. R. Krishnan, *Switched Reluctance Motor Drives – Modeling, Simulation, analysis, Design and Applications*, CRC press, Special Indian Edition, 2015.
5. JB Gupta, *Theory and Performance of Electrical Machines (DC Machines, polyphase circuits and ac machines) in SI Units*, 15th Edition, S.K.Kataria & Sons, New Delhi, 2015.

ADDITIONAL LEARNING RESOURCES:

1. A Video with Animation on Stepper Motor:	https://www.youtube.com/watch?v=eyqwLiowZiU
2. A Video Lecture on Switched Reluctance Motor:	https://www.youtube.com/watch?v=31hUDWjzLjY
3. A Video Lecture on Synchronous Reluctance Motor:	https://www.youtube.com/watch?v=qDon7Nrj1Tk&t=82s
4. Lecture - 35 Step Motor Drives BLDC Drives	https://www.youtube.com/watch?v=Qy6mA4TEpyI
5. A Video Lecture on Linear Motor:	https://www.youtube.com/watch?v=CZbXaNWGAkM

III B. Tech. – II Semester

(19BT60206) **PIC MICROCONTROLLERS AND APPLICATIONS**

(Professional Elective – 2)

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

PRE-REQUISITES: A course on Computer Architecture & Organization.

COURSE DESCRIPTION: Embedded systems concept, PIC Microcontroller Architecture, Peripherals, Programming, Interfacing and their applications.

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

CO1. develop optimized programs using PIC18 assembly instructions by applying the concepts of internal architecture and operation of PIC18 processor.

CO2. develop programs for specific applications using internal Timers, Serial port and I/O ports of PIC18 microcontroller.

CO3. develop programs for specific applications using Interrupts, CCP and ECCP of PIC18 microcontroller.

CO4. develop programs for interface and control of peripherals using PIC18 Microcontroller.

DETAILED SYLLABUS:

UNIT–I: INTRODUCTION TO EMBEDDED SYSTEMS (9 Periods)

Introduction – Characteristics - Von Neumann and Harvard Architecture - CISC and RISC - Instruction pipelining, Microcontrollers and Embedded processors: Microcontroller versus general-purpose microprocessor – History of the PIC microcontroller – PIC18 features, PIC18 Family.

UNIT-II: PIC18 ARCHITECTURE & BASIC PROGRAMMING (9 Periods)

PIC18 architecture and features - PIC18 Memory organization – program memory - data memory - PIC Register file – General Purpose registers - Special Function registers. PIC18 Data Format and Directives - Introduction to PIC18 Assembly Programming – PIC18 programming tools, Instruction set: Data transfer – Arithmetic – logical - bit manipulation - branch Instructions, Addressing modes: Immediate – Direct - Register Indirect Addressing Modes, Macros and Modules, PIC18 programming using MPLAB and PIC 'C' Compile.

UNNIT-III: TIMERS, SERIAL PORT AND I/O PORTS PROGRAMMING (9 Periods)

Timers: Programming Timers 0 and 1 in Assembly language - Programming Timers 2 and 3 in Assembly language, Serial Port: Basics of Serial Communication and PIC Serial Port programming in Assembly language, I/O Ports: Port A TRISA - Port B TRISB - Port C TRISC.

UNIT–IV: INTERRUPTS, CCP AND ECCP PROGRAMMING (9 Periods)

PIC18 Interrupts - Programming Timer Interrupts - Programming the Serial Communication Interrupts - Port-B Change Interrupt, Interrupt Priority in the PIC.

Standard and Enhanced CCP Modules - Compare Mode programming - Capture Mode programming - PWM Programming - ECCP Programming.

UNIT–V: PIC18 INTERFACING (9 Periods)
ADC Characteristics - ADC Programming in the PIC18 - DAC Interfacing - Sensor Interfacing and Signal Conditioning - Relays and Opto-isolators - Stepper Motor Interfacing - DC Motor Interfacing and PWM - PWM Motor Control with CCP - DC Motor Control with ECCP.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Muhammad Ali Mazidi, Rolin D. McKinlay, Danny Causey, PIC Microcontroller and Embedded Systems using assembly and C for PIC 18, Pearson Education, 2008.
2. John B. Peatman, Design with PIC Microcontrollers, Pearson Education, 2007.

REFERENCE BOOKS:

1. PIC18FXXX data sheet.
2. John B. Peatman, Embedded design with the PIC18F452 Microcontroller, Printice Hall, 2003.

ADDITIONAL LEARNING RESOURCES:

1. UDEMY:https://www.udemy.com/course/master-pic-microcontroller-using-mikroc-protuesprofessional/.
3. https://pic-microcontroller.com/online-courses-learn-pic-microcontroller-programming/
4. Coursera: https://www.coursera.org/learn/comparch
5. EDX : https://www.edx.org/learn/computer-architecture

III B. Tech. – II Semester
(19BT50403) VLSI DESIGN
(Professional Elective – 3)

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

PRE-REQUISITES: A Course on Digital Electronics.

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 (8 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. – II Semester
(19BT60207) DESIGN AND ESTIMATION OF ELECTRICAL SYSTEMS
(Professional Elective-3)

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

PRE-REQUISITES: Courses on Basic Electrical and Electronics Engineering Lab, and Transmission and Distribution.

COURSE DESCRIPTION: Design and estimation of residential & commercial buildings, overhead transmission & distribution lines and industrial buildings; Light sources, principals of light & design, types of lamps; electric heating, welding and their applications.

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

CO1. design and estimate the requirements of electrical wiring in residential & commercial buildings adhering Indian electricity rules and standards.

CO2. design and estimate the requirements of overhead transmission and distribution lines adhering Indian electricity rules and standards.

CO3. design and estimate the requirements of electrical wiring for industrial buildings adhering Indian electricity rules and standards.

CO4. design the lighting system for various industrial and domestic applications following the design procedures and laws of illumination.

CO5. understand various methods of heating and welding process and their applications.

DETAILED SYLLABUS:

UNIT-I: DESIGN AND ESTIMATION OF RESIDENTIAL AND COMMERCIAL BUILDINGS (11 Periods)

Introduction to residential wiring system, systems of distribution of electric energy, methods of wiring, systems of wiring, choice of wiring, rating of wires and cables, load calculations and selection of size of conductor. Estimation & costing for residential and commercial buildings. Indian Electricity Act and major applicable Indian Electricity (I.E) rules.

UNIT-II: DESIGN AND ESTIMATION OF OVERHEAD TRANSMISSION & DISTRIBUTION LINES (09 Periods)

Introduction, components of overhead lines, conductor materials, determination of size of conductor for overhead transmission line, conductors' configuration, spacing and clearances, span lengths. Preparation of detailed estimates and costing of overhead transmission and distribution lines.

UNIT-III: DESIGN AND ESTIMATION OF INDUSTRIAL NETWORK INSTALLATIONS (09 Periods)

Introduction and classification of industrial buildings, design process, Industries with less than or equal to 1MVA and above 1MVA load, selection of distribution architecture, selection of transformer substations, selection of drives, selection of switch gears.

UNIT-IV: PRINCIPLES OF LIGHT AND DESIGN (10 Periods)
Light sources, colour characteristics, terms used in illumination, laws of illumination, polar curves, photometry - integrating sphere. Types of lamps, LED lights, photometric analysis, lighting calculations, average lumen method, light loss factor, quality of lighting, design procedures, arrangement of fixtures, factory lighting, street lighting and flood lighting.

UNIT-V: ELECTRIC HEATING AND ELECTRIC WELDING (06 Periods)
Electric heating: Design of heating element, advantages, methods and applications - resistance, induction and dielectric heating.
Electric welding: Classification, resistance and arc welding, electric welding, comparison between AC and DC welding.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. J.B.Gupta, *A Course in Electrical Installation Estimating and Costing*, Reprint Edition, S.K.Kataria and Sons, 2013.
2. M. K. Giridharan, *Electrical Systems Design*, 3rd Edition, I K International Publishing House Pvt. Ltd, 2015.

REFERENCE BOOKS:

1. Hemant Joshi, *Residential - Commercial and Industrial Electrical Systems: Network and Installation (Volume 1)*, 21st Edition, McGraw Hill Education, 2007.
2. Hemant Joshi, *Residential - Commercial and Industrial Electrical Systems: Network and Installation (Volume 2)*, 21st Edition, McGraw Hill Education, 2007.
3. J.B.Gupta, *Utilization of Electric Power and Electric Traction*, 10thEdition, S.K.Kataria and Sons, 2013.

ADDITIONAL LEARNING RESOURCES:

1. https://bis.gov.in/index.php/standards/technical-department/national-building-code/

III B. Tech. – II Semester

(19BT60208) DISTRIBUTED GENERATION AND MICROGRID

(Professional Elective – 3)

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

PRE-REQUISITES: A Course on Transmission and Distribution.

COURSE DESCRIPTION: The course concerns with, the significance of distributed generation with centralized grid and microgrid, also the protection systems on various generation equipment and communication systems for the distribution generation and microgrids.

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

CO1. understand the technical and economic aspects of distributed generations, and their impact on environment.

CO2. understand various energy resource appropriate for distribution generation and their interfacing issues.

CO3. plan the generation capacity to meet the thermal generation adequacy and appropriate protection system for distributed generation and networks.

CO4. develop models of microgrid to assess energy management and coordination of protection system of the grid operating in different modes.

CO5. understand the operational challenges and communication protocols of microgrid, and its impact on environment and society.

DETAILED SYLLABUS:

UNIT-I: OVER VIEW OF DISTRIBUTED GENERATION (9 Periods)

Distribution Generation - Introduction, Necessity, Benefits of integration. Distributed Generation – Technical aspects, Impacts on Environmental, Economics aspects, transmission system and central generation.

UNIT-2: ENERGY RESOURCES FOR DISTRIBUTED GENERATION (9 Periods)

Combined heat and power systems; Wind energy conversion systems; Solar photovoltaic systems; Small-scale hydroelectric power generation; Other renewable energy sources; Storage devices and Inverter interfaces.

UNIT-3: DG PLANNING AND PROTECTION (9 Periods)

Generation capacity, adequacy in conventional thermal generation systems; Impact of distributed generation on network design; Protection of distributed generation and distribution network.

UNIT-4: CONCEPT OF MICROGRID (9 Periods)

Microgrid - introduction and configuration; Functions of Micro source controller and central controller; Energy Management and Protection Co-ordination Module; Modes of Operation: Grid connected and islanded modes; Modelling of Microgrid : Micro-turbine Model, PV Solar Cell Model, Wind Turbine Model; Role of Microgrid in power market competition.

UNIT-5: IMPACTS OF MICROGRID (9 Periods)

Technical and economical aspects of Microgrid ; Challenges of Microgrid development; Management and operational issues of a Microgrid ; Impacts of Microgrids on heat utilization, process optimization, energy market, environment, communication standards and protocols.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Nick Jenkins, Janaka Ekanayake, Goran Strbac, *Distributed Generation*, Institution of Engineering and Technology, London, UK, 2010.
2. S. Chowdhury, S.P. Chowdhury and P. Crossley, *Microgrids and Active Distribution Networks*; The Institution of Engineering and Technology, London, United Kingdom, 2009.

REFERENCES:

1. Math H. Bollen, Fainan Hassan, *Integration of Distributed Generation in the Power System*, John Wiley & Sons, New Jersey, 2011.
2. Magdi S. Mahmoud, Fouad M. AL-Sunni, *Control and Optimization of Distributed Generation Systems*, Springer International Publishing, Switzerland, 2015.
3. Nadarajah Mithulananthan, Duong Quoc Hung, Kwang Y. Lee, *Intelligent Network Integration of Distributed Renewable Generation*, Springer International Publishing, Switzerland, 2017.

ADDITIONAL LEARNING RESOURCES:

1. NPTEL Videos : https://nptel.ac.in/courses/108/108/108108034/
2. IEEE Distributed generation and its impact on power grids and microgrids protection : https://ieeexplore.ieee.org/document/6201229

III B. Tech. – II Semester
(19BT60209) POWER SYSTEM AUTOMATION
(Professional Elective-3)

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

PRE-REQUISITES: A course on Power Systems Operation and control**.**

COURSE DESCRIPTION: Power system control and deregulation; Power system automation — Substation and distribution automation; Energy control centers.

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

CO1. understand the various modes of power system operation and interpret various market models of deregulated power system.

CO2. understand the power system automation procedures, communication systems, and norms for data acquisition for automation.

CO3. understand the role and responsibility of transmission control center in monitoring and maintaining the security of the transmission network following the relevant standards.

CO4. understand the role and responsibility of distribution control center to automate the distribution system using distributed management system following the relevant standards.

DETAILED SYLLABUS:

UNIT-I: POWER SYSTEM CONTROL AND DEREGULATION (08 Periods)

Introduction — Operation of power systems and modes, Organization and operator activities, Investment factor and control centre experiences. Deregulation — need for deregulation and Advantages of deregulation in power system; Restructuring Models — PoolCo. Model, Bilateral Model and Hybrid Model; Independent system operator (ISO) — Role of ISO; Congestion Management.

UNIT-II: POWER SYSTEM AUTOMATION (10 Periods)

Evolution of automation systems; SCADA in Power system; Building blocks of SCADA system; Remote terminal unit; Intelligent electronic devices; Data concentrators and merging units; SCADA communication systems; Master station; Human-machine interface; Classification of SCADA systems.

UNIT-III: SUBSTATION AUTOMATION (09 Periods)

Substation automation, conventional automation; new smart devices for substation automation; new integrated digital substation; technical issues new digital simulation; Substation automation architectures; substation automation applications functions; Benefits of data warehousing.

UNIT-IV: ENERGY CONTROL CENTERS (10 Periods)

Introduction — Energy control centers; EMS framework; Data acquisition and communication; Generation operation and management; Transmission operations and management: Real time Study-mode Simulations; Post-event analysis and energy scheduling and accounting; Dispatcher training simulator; Smart transmission.

UNIT-V: DISTRIBUTION AUTOMATION (08 Periods)

Introduction to Distribution automation — Customer, feeder and substation automation; Subsystems in a distribution control center; Distributed Management System (DMS) framework integration with subsystems; advanced real-time DMS applications; Advanced analytical DMS applications; DMS coordination with other systems.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. M Shahidehpour, Muwaffaq Alomoush, *Restructured electrical power systems operation, trading and volatility*, CRC Press, 1st Edition, 2001.
2. Mini S Thomas and John D Mcdonald, *Power System SCADA and Smart Grids*, CRC Press, 1st Edition 2015.

REFERENCE BOOKS:

1. Torsten cegrell, *Power systems control Technology*, Prentice Hall, 1st Edition, 1986.
2. James Northcote-Green and Robert Wilson, *Control and Automation of Electrical Power Distribution Systems*, CRC Press, 1st Edition, 2013.
3. Edmund Handschin, *Real time control of Electric Power System*, Elsevier Publishing company, 1st Edition, 1972.

ADDITIONAL LEARNING RESOURCES

1. https://www.eit.edu.au/cms/courses/industrial-automation-instrumentation-process-control/professional-certificate/in-iec-61850-based-substation-automation.
2. https://nptel.ac.in/courses/108106022/8.
3. https://nptel.ac.in/courses/108/101/108101005/

III B. Tech. – II Semester

(19BT50406) **FPGA ARCHITECTURES AND APPLICATIONS**

(Inter Disciplinary 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 Digital Electronics, and 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 (9 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 (8 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 (8 Periods)
Introduction, Programming Technology, Device Architecture, the Xilinx XC2000, XC3000 and XC4000 Architectures.

UNIT-IV: ANTI-FUSE PROGRAMMED FPGAs (10 Periods)
Introduction, Programming Technology, Device Architecture, The Actel ACT1, ACT2 and ACT3 Architectures.

UNIT–V: DESIGN APPLICATIONS (10 Periods)
General Design Issues, A Fast Video Controller, A Position Tracker for a Robot Manipulator, A Fast DMA Controller, Designing Counters with ACT devices.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Stephen M. Trimberger, *Field Programmable Gate Array Technology*, Springer International Edition, 8^{th} Indian Reprint 2015.
2. Charles H. Roth Jr, Lizy Kurian John, *Digital Systems Design using VHDL, 3^{rd} Edition,* Cengage Learning, 2017.

REFERENCE BOOKS:

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

ADDITIONAL LEARNING RESOURCES

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
(19BT60407) IMAGE PROCESSING
(Inter Disciplinary Elective-2)
(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 Netwroks and 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, 2nd Edition, 2020.
2. Vipula Singh, *Digital Image Processing with MATLAB & LabVIEW*, Elsevier, 2019.

III B. Tech. – II Semester
(19BT50408) MICROELECTROMECHANICAL SYSTEMS
(Inter Disciplinary Elective-2)

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

PRE-REQUISITES: A Course on Engineering Physics.

COURSE DESCRIPTION: Overview of Micro Electro Mechanical Systems (MEMS), working principles of microsensors and microactuators; materials, micro fabrication processes, MEMS accelerometers; packaging of Microsystems and applications over different fields.

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

CO1. demonstrate MEMS Components like microsensors and microactuators.
CO2. understand working methodologies of MEMS accelerometers.
CO3. use micro fabrication techniques and device packaging methods in manufacturing MEMS devices.
CO4. analyze various MEMS devices for engineering applications.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO MEMS AND MICROSYSTEMS (09 Periods)
Introduction to MEMS, Energy domains and transducers, sensors and actuators, Microsystems versus MEMS, miniaturization, MEMS materials.

UNIT-II: MICROSENSORS & ACTUATORS (09 Periods)
Microsensors: Classification of physical sensors, Integrated, Intelligent or Smart sensors, Sensor Principles and Examples: Thermal sensors, Pressure, Flow, Inertial, Gyro sensors, Bio Sensors.
Microactuators: Electromagnetic and Thermal microactuation, Mechanical design of microactuators, Microactuator examples, microvalves, micropumps, micromotors.

UNIT-III: MEMS ACCELEROMETERS (07 Periods)
Micro accelerometers for MEMS, Temperature and Damping analysis, Piezoelective accelerometer, Piezoresistive accelerometer, Piezocapacitive accelerometer technology.

UNIT-IV: **MEMS FABRICATIONAND PACKAGING (12 Periods)**
Review of Fabrication process-Photolithography, ion implantation, diffusion, oxidation, chemical vapor deposition, physical vapor deposition, deposition by Epitaxy, Czochralski process.
Micromachining technology of MEMS, Microstereolithography; Introduction to microsystem packaging, objectives and general considerations in packaging design, three levels of microsystem packaging.

UNIT-V: MEMS APPLICATIONS (08 Periods)
Applications of MEMS in the automotive industry, avionics and space applications and commercial applications, RF MEMS, optical MEMS, Introduction to Bio MEMS and microfluidics.

Total Periods: 45

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

TEXT BOOK:

1. Tai-Ran Hsu, *MEMS & Microsystems, Design and Manufacture*, McGraw Hill Education (India) Pvt. Ltd., 27th reprint, 2018.

REFERENCE BOOKS:

1. G.K.Ananthasuresh, K.J.Vinoy, *Micro and Smart Systems*, New Delhi publication, 1st Edition, 2011 Education (India) Pvt. Ltd.
2. Nitaigour Premchand Mahalik, *MEMS*, McGraw Hill Education (India) Pvt. Ltd., 11th reprint, 2016.

III B. Tech. – II Semester
(19BT61003) INDUSTRIAL DATA COMMUNICATIONS
(Inter Disciplinary 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 data communication.
CO2: analyze interfacing standards EIA-232 and EIA-485.
CO3: select a communication protocol for particular application.
CO4: demonstrate knowledge on foundation fieldbus.

DETAILED SYLLABUS:

UNIT-1: Industrial Data Communication Methodology (9 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-2: EIA-232 & EIA-485 Interface Standard (9 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-3: HART Protocol & AS-interface (AS-i) (7 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-4: 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-5: Foundation Fieldbus **(9 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 BOOKS:

1. Steve Mackay, Edwin Wrijut, Deon Reynders, John Park, Practical Industrial Data Networks Design, Installation and Troubleshooting' Newnes Publication, Elsevier 1st 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
(19BT60231) ELECTRICAL CAD LAB

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

PRE-REQUISITES: A course on Computer Aided Engineering Drawing.

COURSE DESCRIPTION: Drafting standards for electrical engineering applications; Drafting of residential electrical layouts and electrical sub-station.

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

CO1. demonstrate preliminary design aspects of electrical design using CAD.
CO2. develop preliminary and detailed single line diagrams of complete electrical load distribution in a residential building.
CO3. develop wiring layouts for lighting, power and Air conditioning applications in residential accommodations.
CO4. develop a typical electrical layout of industrial blue prints and control appliances for industrial applications.
CO5. work independently or in teams to solve problems with effective communication.

Practical Exercises/List of Experiments: Minimum **Ten** experiments are to be conducted.

PART-A: Electrical Design Concepts (Compulsory)

1. Review of preliminary electrical designing
2. Exercise on three phase load balancing

PART-B: Drafting Exercises (Minimum Eight)

3. Typical residential floor plan
4. Lighting load wiring layouts for a residential accommodation
5. Power load wiring layouts for a residential accommodation.
6. AC load wiring layouts for a residential accommodation.
7. Typical house electrical wiring schematic circuit.
8. Preliminary single line diagram for a residential electrical system.
9. Detailed single line diagram for a residential electrical system.
10. Typical electrical wiring diagram for an industrial workshop.
11. Single line diagram of a typical electrical substation.
12. Schematic diagram of a motor control center.

TEXT BOOKS:

1. National Building Code of India 2005.
2. Gaurav Verma and Matt Weber, AUTOCAD Electrical 2016 Black Book, CADCAMCAE works, USA, 2015 (http://1.droppdf.com/files/YooGv/autocad-electrical-2016-black-book-by-gaurav-verma-2015.pdf)

ADDITIONAL LEARNING RESOURCES:

1. https://www.youtube.com/watch?v=zTo8QL7A-wg

2. https://www.youtube.com/watch?v=6VXybp4g4vU
3. https://www.youtube.com/watch?v=fCJtarn6Jvg
4. https://www.youtube.com/watch?v=B0x-OHR-1Pk

SOFTWARE/Tools used:

1. Electrical CAD (AutoCAD for Electrical and Electronics Engineers)

III B. Tech. – II Semester
(19BT60232) **ELECTRICAL POWER SYSTEMS LAB**

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

PRE-REQUISITES: A course on Electrical Machines-II.

COURSE DESCRIPTION: Experimental investigations on behavior of insulators, performance of synchronous and asynchronous machines, relay testing and fault analysis.

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

CO1. analyze the behavior of various dielectric materials/insulators in the presence of high voltage and determine their withstand limits.

CO2. evaluate the operational parameters and characteristics of the transformers operating under different scenarios.

CO3. analyze the performance of synchronous and asynchronous machines operating under different scenarios.

CO4. evaluate various electrical parameters and interpret the experimental observations with underlying concepts.

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. Determination of Corona inception characteristics.
2. Determination of efficiency of string insulator.
3. Determination of dielectric strength of liquid insulating material.
4. Determination of dielectric strength of gaseous dielectrics under uniform and non uniform electric fields.
5. Determination of equivalent circuit of a 3-winding transformer.
6. Determination of positive, negative and zero sequences of a three phase transformer.
7. Determination of sequence impedances of a Synchronous Machine.
8. Determination of sub-transient reactance of salient pole alternator.
9. Power Angle Characteristic of Three-Phase Salient Pole Synchronous Machine.
10. Performance of three phase induction motor under two phase supply.
11. Ascertain I-V and P-V Characteristics of PV module.
12. Three phase active power and energy measurement using two instrument transformers.

TEXT BOOKS:

1. C. L. Wadhwa, Electrical Power systems, New Age International (P) Limited, Publishers, New Delhi, 5th Edition, 2009.
2. JB Gupta, *Theory and performance of Electrical Machines*(DC machines, Poly phase Circuits & AC machines) in SI Units, S.K. Kataria& Sons, New Delhi, 15th Edition, 2015.

REFERENCE BOOKS:

1. John J. Grainger and William D. Stevenson, Jr., *Power System Analysis*, McGraw-Hill, 2003.
2. P.S. Bimbhra, *Electrical Machinery*, Khanna Publishers, 7th Edition, Delhi, 2011.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/101/108101039/
2. http://www.ee.iitkgp.ac.in/faci_ps.php
3. https://www.youtube.com/watch?v=tgjayvDVW28
4. https://www.youtube.com/watch?v=_0T2Osgxdxs

III B. Tech. – II Semester
(19BT60233) **SOCIALLY RELEVANT PROJECT-II**

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

PRE-REQUISITES: -

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 (6 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 (6 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 (6 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 (6 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 (6 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

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 Behaviour; Individual behaviour and Personality; Interpersonal and group behaviour; 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 behaviour to understand the behaviour of people in the organization.
CO3. Analyze the complexities associated with management of the individual, group behaviour in the organization.
CO4. Develop leadership qualities.
CO5. Improve individual behaviour, skill and life-long learning in a group.

DETAILED SYLLABUS:

UNIT – I: INTRODUCTION TO ORGANIZATIONAL BEHAVIOUR (9 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 (9 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 BEHAVIOUR (9 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 (9 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 (9 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
(19BT70201) **SOLID STATE DRIVES**

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

PRE-REQUISITES: Courses on Electrical Machines–II, Control Systems and Power Electronics.

COURSE DESCRIPTION: DC drives — Controlled rectifier and chopper fed DC motors; AC drives — Inverter fed induction motor; Special motor fed drives — Synchronous and stepper motors.

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

CO1. evaluate the characteristics and operational aspects of drives operating in different modes.

CO2. analyze the operational aspects of various DC drives operating in different sustainable modes of operation.

CO3. analyze the operational aspects of various asynchronous motor drives operating in different sustainable modes of operation.

CO4. analyze the operational aspects of synchronous motor and stepper motor drives operating in different sustainable modes of operation.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO ELECTRIC DRIVES (10 Periods)

Electrical drives — block diagram, advantages of electric drive, parts of electric drives, choice of electrical drives, status of DC and AC drives. Dynamics of electrical drives — fundamental torque equations, speed-torque conventions and multi-quadrant operation; Equivalent values of drive parameters — loads with rotational and translational motion; Load torques — components, nature and classification. Concept of steady state stability. Electric braking methods — regenerative, dynamic and plugging. Modes of operation of electrical drives — steady state, acceleration including starting and deceleration including stopping. Speed control and drive classifications, closed loop control of drives — current limit control, torque control, speed control and position control (Block diagram only).

UNIT-II: SINGLE PHASE AND THREE PHASE CONVERTER FED DC DRIVES (10 Periods)

Control of DC separately excited motor by single-phase and three-phase half and full bridged converters — voltage and current waveforms for continuous and discontinuous conduction, speed-torque expressions and characteristics. Single phase half controlled rectifier fed DC series motor — voltage and current waveforms for continuous and discontinuous conduction, speed-torque expressions and characteristics. Multi-quadrant operation of DC separately excited DC motor fed from fully controlled rectifier — mechanical reversible switch in armature, dual converter and field current reversal.

UNIT-III: DC CHOPPER FED DRIVES (07 Periods)

Control of DC separately excited motor by one, two and four quadrant choppers — voltage and current waveforms for continuous conduction (motoring, regenerative and dynamic braking), speed-torque expressions and characteristics. Chopper control of DC series motor — operation, speed-torque expressions and characteristics. Closed loop chopper control of separately excited DC motor (Block diagram only).

UNIT-IV: INDUCTION MOTOR DRIVES (12 Periods)

Three phase induction motors — Introduction, Stator variable voltage control — speed-torque characteristics, AC voltage controllers and efficiency of induction motor under voltage control. Stator variable voltage and variable frequency control — slip speed control, torque-power limitations and modes of operation. Voltage Source Inverters (VSIs) and Current Source Inverters (CSIs) fed induction motor and closed loop operation of induction motor drives (Block diagram only). Comparison of VSI and CSI fed drives. Static rotor resistance control, slip power recovery schemes — static scherbius and kramer drive, speed-torque characteristics.

UNIT-V: SYNCHRONOUS AND STEPPER MOTOR DRIVES (06 Periods)

Synchronous Motor Drives: Separate control and self control of synchronous motors — operations of self controlled synchronous motors by VSI and CSI. Load commutated CSI fed Synchronous motor — operation and speed torque characteristics. Closed loop control operation of synchronous motor drives (Block diagram only).
Stepper Motor Drives: Variable reluctance and permanent magnet operation — features of stepper motor — torques Vs stepping rate characteristics and drive circuits.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Gopal K. Dubey, *Fundamentals of Electric Drives*, Narosa Publications, Alpha Science International Ltd, 2nd Edition, 2002.
2. Krishnan, Ramu. *Electric motor drives: modeling, analysis, and control*, 1st Edition, Pearson, 2015.

REFERENCE BOOKS:

1. Gopal K. Dubey, *Power Semiconductor Controlled Drives*, Prentice-Hall International, 1989.
2. P. C. Sen, *Principles of Electrical Machines and Power Electronics*, Wiley, 3rd Edition, 2013.
3. M.D. Singh, K.B. Khanchandani, *Power Electronics*, Tata McGraw-Hill, 2nd Edition, 2013.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/104/108104140/
2. https://nptel.ac.in/courses/108/102/108102046/
3. https://swayam.gov.in/nd1_noc19_ee65/preview

IV B. Tech. – I Semester
(19BT70202) **SWITCHGEAR AND PROTECTION**

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

PRE-REQUISITES: A course on Transmission and Distribution.

COURSE DESCRIPTION: Overview of protection schemes; Circuit breakers; electromagnetic, static and microprocessor based relays; Protection schemes for various components under various operating conditions; Various grounding schemes.

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

- CO1. apply the conceptual knowledge of various circuit breakers for secured operation of power system network.
- CO2. apply the conceptual knowledge of various relays for secured operation of power system network.
- CO3. analyze various protection schemes for the protection of generators, transformers and bus bars.
- CO4. analyze various protection schemes for the protection of transmission lines and feeders.
- CO5. apply various neutral grounding methods and determine the system parameters for protection in power system.

DETAILED SYLLABUS:

UNIT-I: CIRCUIT BREAKER (9 Periods)

Circuit breakers — Elementary principles of arc interruption, recovery voltage, restriking voltage, RRV, average and maximum RRRV; Current chopping and resistance switching; Construction and principle of operation — minimum oil circuit breaker, air blast circuit breaker, vacuum circuit breaker and SF_6 circuit breaker; Isolator.

UNIT-II: RELAYS (12 Periods)

Electromagnetic relays: Types of relays, construction, operation of induction type relays, differential relays and biased differential relays. Universal torque equation — Characteristics of overcurrent, directional and distance relays.

Static relays: Advantages and disadvantages, block diagram of a basic static relay; Definite time, inverse and inverse definite minimum time (IDMT). Comparators — amplitude and phase comparators.

Microprocessor based relays: Advantages and disadvantages, block diagram with flow charts — distance relays and over current relays — definite, inverse & IDMT.

UNIT-III: PROTECTION OF GENERATORS AND TRANSFORMERS (8 Periods)

Protection of generators: Rotor protection; Stator protection — restricted earth fault protection and internal fault protection; Other faults — unbalanced loading, overloading protection, over-speed protection, over-voltage protection, failure of prime mover, loss of excitation; Calculation of percentage winding unprotected.

Transformer protection: Types of faults, Percentage differential protection, CT's ratio, Buchholz relay
Protection of bus bars: Differential protection.

UNIT-IV: PROTECTION OF FEEDERS AND TRANSMISSION LINES (10 Periods)
Protection of transmission lines: Protection through directional and distance relays (R-X); Three-zone distance protection using distance relays; Carrier current protection using over current relays.
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, Insulation coordination, basic impulse insulation level (BIIL).

UNIT-V: NEUTRAL GROUNDING (6 Periods)
Grounded and ungrounded systems. Effects of ungrounded neutral on system performance. Methods of neutral grounding — solid, resistance, reactance, arc suppression coil (Peterson coil), grounding practices.

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. Badri Ram, D. N. Viswakarma, *Power System Protection and Switchgear*, 2nd Edition, McGraw Hill education (India) Private Limited, New Delhi, 2011.

REFERENCE BOOKS:

1. C. L. Wadhwa, *Electrical Power systems*, 7th Edition, New Age International (P) Limited, Publishers, New Delhi, 2017.
2. T. S. Madhava Rao, *Power System Protection: Static Relays with Microprocessor Applications*, Tata McGraw-Hill Publishing Company Limited, New Delhi, 2nd Edition, 2004.

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.youtube.com/watch?v=LPQiajWeijY&list=PLBVJZMfxcrJn3p03lxsOP_ivHXzFLysYE

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 Digital Electronics, 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
(19BT70203) **ANALYSIS OF POWER ELECTRONIC CONVERTERS**
(Professional Elective–4)

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

PRE-REQUISITES: A course on Power Electronics.

COURSE DESCRIPTION: Advanced Power Semiconductor devices; MOSFET and IGBT-Gate and base drive circuits; 3, 6 and 12-pulse converters; Switching regulators; Advanced PWM Techniques.

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

CO1. understand the operational principle of switching phenomenon/characteristics of various special power switching devices.
CO2. analyze the operational characteristics of various transistor and thyristor gate driver circuits.
CO3. analyze various multi-pulse converters operating in different modes and determine their operational parameters.
CO4. design various switching regulators and analyze their performance in different modes of operation.
CO5. analyze the performance and application of advanced PWM techniques in inverter configurations.

DETAILED SYLLABUS:

UNIT-I: ADVANCED POWER SEMICONDUCTOR DEVICES (10 Periods)
Thyristors: GTOs—Construction, operation, steady state characteristics and switching characteristics; Construction and operation of BCTs, FET — CTHs, ETOs, IGCTs, MCTs, SITHs, ASCR, RCT, SCS and light activated thyristor; Comparison of various thyristors; Transistors: Construction and operation of COOLMOS and SITs.

UNIT-II: GATE & BASE DRIVE CIRCUITS (10 Periods)
MOSFET and BJT gate drive circuits; Isolation of gate and base drives — pulse transformer, opto-couplers; Thyristor firing circuits — R, RC firing circuits, photo-SCR isolator, pulse transformer isolation for inverter gate bias circuits and thyristor converter gating circuits; Gate drive ICs — MOSFETs and IGBTs; Drive ICs for converters — MOS Gated Driver.

UNIT-III: ANALYSIS OF MULTIPULSE CONVERTERS (09 Periods)
Operation of 3-, 6-, and 12- pulse converters; Performance analysis of 3-, 6-, and 12-pulse converters — Low Order Harmonics (LOH), Total Harmonic Distortion (THD), Power Factor, Ripple Factor, Form Factor, Distortion Factor.

UNIT-IV: SWITCHING REGULATORS (08 Periods)
Design and analysis of buck, boost, buck-boost, Cuk and SEPIC Converters. Resonant Converters — Zero Voltage Switching (ZVS) and Zero Current Switching (ZCS) converters — M and L Type.

UNIT-V: ADVANCED PWM TECHNIQUES **(08 Periods)**

Modified Sinusoidal Pulse Width Modulation; Phase Displacement Control; Trapezoidal Modulation Technique; Staircase Modulation; Stepped Modulation; Harmonic Injection Modulation; Delta Modulation; Selective Harmonics Elimination (SHE) Technique, Space Vector PWM.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Muhammad H. Rashid, *Power Electronics – Devices, Circuits and Applications*, 4th Edition, Pearson, 2017.
2. Ned Mohan, T. M. Undeland, W.P. Robbins, *Power Electronics: Converters, Applications and Design*, Wiley, 3rd Edition, 2007.

REFERENCE BOOKS:

1. P C Sen, *Modern Power Electronics*, Wheeler publishing Co, 1st Edition, New Delhi, 1998.
2. Bimal K Bose, *Modern Power Electronics and Drives*, Pearson Education, 2nd Edition, 2003.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108/107/108107128/
2. https://nptel.ac.in/courses/108/105/108105066/
3. https://nptel.ac.in/courses/108/102/108102145/

IV B. Tech. – I Semester

(19BT70204) **ELECTRIC VEHICLES**

(Professional Elective–4)

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

PRE-REQUISITES: Courses on Electrical Machines-II and Power Electronics.

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 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, and 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 determine the performance/operational parameters of electric vehicle.

CO4. analyze various battery energy storage systems and assess their adaptability for sustainable performance of electric vehicle.

CO5. understand the various types of magnetic gears for electric vehicles and apply them for sustainable mobility of vehicles.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO EVS AND HEVS (08 Periods)

Environmental impact and history of modern transportation, history of transportation electrification, Electric Vehicles (EVs) — introduction, configurations and 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.

UNIT-II: POWER CONVERTERS IN EVS (10 Periods)

Introduction, isolated DC-DC converter — advantages, forward converter, CCM currents in forward converter, CCM voltages in forward converter and sizing the transformer. Isolated full-bridge converter, operation, CCM currents in full-bridge converter and CCM voltages in the full-bridge converter. Resonant power conversion — LCLC series-parallel resonant converter, desirable converter characteristics for inductive charging and fly-back converter. Bi-directional battery chargers and contactless charging.

UNIT-III: ELECTRIC PROPULSION SYSTEMS (09 Periods)

Stator-PM versus rotor-PM, system configurations, doubly salient PM motor drives, flux-reversal PM motor drives, flux-switching PM motor drives, hybrid-excited PM motor drives, flux-mnemonic PM motor drives, magnet less flux switching motor drives and design criteria for EVs.

UNIT-IV: ENERGY STORAGE TECHNOLOGIES (09 Periods)
Battery — basic theory and characterization, battery technologies, types — lead acid batteries, nickel-based batteries and lithium-based batteries. Ultra-capacitors — features, basic principles, performance, battery modeling based on electric equivalent circuit, modeling of ultra-capacitors, battery charging control and flywheel energy storage system. Fuel cells — modeling and block diagrams of hybrid fuel cell energy storage systems.

UNIT-V: MAGNETIC GEAR FOR EV TRANSMISSION SYSTEMS (09 Periods)
Introduction, system configurations, types, Magnetic Gear (MG) machines — principle, modelling, control and design criteria for MG motor drives. Magnetic Gear Electric Variable Transmission (MG EVT) systems — multiport magnetic gears, magnetic planetary-geared EVT system, magnetic concentric-geared EVT system and applications.

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. Mehrdad Ehsani, Yimin Gao and Ali Emadi, Modern Electric, *Hybrid Electric and Fuel Cell Vehicles*, 2nd Edition, CRC Press, 2015.

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

(19BT70205) FLEXIBLE AC TRANSMISSION SYSTEM

(Program Elective – 4)

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

PRE-REQUISITES: Courses on Power Electronics and Power System Analysis.

Course Description: Need for flexible AC transmission systems; objectives of shunt and series compensations, phase angle regulators; FACTS controllers: shunt, series and combined; coordination of various FACTS controllers.

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

CO1. understand the power flow aspects in AC transmission system and realize the need of compensation and philosophy of FACTS controllers.

CO2. realize the principle of static shunt compensation techniques and apply an appropriate shunt controller for sustainable operation of AC transmission system.

CO3. realize the principle of static series compensation techniques and apply an appropriate series controller for sustainable operation of AC transmission system.

CO4. realize the philosophy of various power flow controllers operating in various modes to control the active and reactive power and foster sustainable operation of AC transmission system.

CO5. realize the principle of multiple FACTS controllers in AC transmission system and techniques to coordinate them for sustainable operation.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO AC TRANSMISSION SYSTEMS (7 Periods)

Overview of interconnected power system. Power flow in AC systems – Expression for real and reactive power flow between two nodes of a power system, controllable parameters. Power flow in parallel and meshed system. Overview of compensated transmission lines – shunt and series compensation. Conventional controllers for real and reactive power flows – merits and demerits. FACTS – benefits, types of FACTS controllers.

UNIT-II: STATIC SHUNT COMPENSATION (10 Periods)

Expression for real and reactive power flow with mid-point voltage regulation. Variable impedance type static VAR generators - V-I characteristics and control schemes of TCR, TSR, TSC. QD-QO characteristic and control scheme of TSC-TCR. Switching converter type VAR generators – V-I characteristics and control schemes of STATCOM. Hybrid VAR generators – V-I characteristics of SVC and STATCOM, regulation of V-I slope. Applications of static shunt compensators – Voltage regulation, improvement in transient stability, prevention of voltage instability, power oscillation damping. Comparison of static shunt compensators.

UNIT-III: STATIC SERIES COMPENSATION (10 Periods)

Expression for real and reactive power flow with series line compensation. Variable impedance type series compensators: V-I characteristics and control schemes of GCSC, TSSC, TCSC- modes of operation. Sub-synchronous resonance. Switching converter type series compensator – V-I characteristics, internal and external control schemes of SSSC. Applications of static series compensators – improvement in transient stability, power oscillation damping. Comparison of static series compensators.

UNIT-IV: STATIC PHASE ANGLE REGULATORS AND COMBINED COMPENSATORS (10 Periods)

Power flow control by phase angle regulators - Concept of voltage and phase angle regulation. Operation and control of TCVR and TCPAR. Switching converter type phase angle regulators. Objectives of TCPAR - improvement of transient stability, power oscillation damping. UPFC – Principle, expression for real and reactive power between two nodes of UPFC, independent real and reactive power flow control using UPFC, control schemes of UPFC - operating principle and characteristics of IPFC.

UNIT-V: CO-ORDINATION OF FACTS CONTROLLERS (8 Periods)

FACTS controller interactions – interaction between multiple SVC's – interaction between multiple TCSC's – SVC-TCSC interaction – Coordination of multiple controllers using linear control techniques. Comparative evaluation of different FACTS controllers: performance comparison and cost comparison, Control coordination using Genetic Algorithm, Future direction of FACTS technology.

Total periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Narain G. Hingorani, Laszi Gyugyi, *Understanding FACTS: Concepts and Technology of Flexible AC Transmission Systems*, Wiley-IEEE Press, 1999.
2. R. Mohan Mathur and Rajiv k. Varma, *Thyristor based FACTS Controllers for Electrical Transmission Systems*, Wiley-IEEE Press, 2002.

REFERENCE BOOKS:

1. Xiao-Ping, Rehtanz, Christian, Pal, Bikash, *Flexible AC Transmission Systems: Modeling and Control*, Springer Power Systems Series, 2006.
2. T.J.E. Miller, *Reactive Power Control in Electric Systems*, Wiley, 1982.

IV B. Tech. –I Semester

(19BT70206) DIGITAL SIGNAL PROCESSING FOR ELECTRICAL ENGINEERS

(Professional Elective-5)

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

PRE-REQUISITES: A course on Signals & Networks.

COURSE DESCRIPTION: Discrete-time signals and systems; Discrete Fourier series, Discrete Fourier Transforms (DFT) and Fast Fourier Transform (FFT) algorithms for the analysis of discrete time sequences; design and realization of digital IIR and FIR filters; DSP based control of stepper motors; DSP based implementation of DC-DC buck-boost converters.

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

CO1. perform various operations on signals by applying the concepts of Fourier, z-transform and realize the behavior of systems.

CO2. analyze various discrete time signals and systems using DFT and evaluate the discrete Fourier transform of discrete time signals using FFT techniques.

CO3. design and realize IIR and FIR digital filters using various transformation and realization methods.

CO4. apply relevant DSP controllers for various engineering applications.

DETAILED SYLLABUS:

UNIT-I: FUNDAMENTALS OF DSP (07 Periods)

Review of discrete time signals and systems, Solutions for difference equation of discrete time systems, frequency response of discrete time signals, A/D and D/A conversion, Introduction to DSP system with block diagram.

UNIT-II: FOURIER TRANSFORMS (10 Periods)

Discrete Fourier Transforms — Introduction, relation with other transforms, properties, circular and linear convolution. Fast Fourier Transforms — Radix-2 Decimation in time and Decimation in frequency algorithms.

UNIT-III: IIR DIGITAL FILTERS (10 Periods)

Digital Vs Analog filters, advantages and disadvantages of digital filters; Analog low pass filter design: Butterworth and Chebyshev low pass filters. Design of IIR filter from analog filters using Impulse Invariance and Bilinear transformation techniques. Frequency transformation in digital domain (theoretical approach); Realization of IIR Digital filters using Direct form-I and Direct form-II structures.

UNIT-IV: FIR DIGITAL FILTERS (8 Periods)

Introduction to linear phase FIR filters, Fourier series method for design of FIR filters. Design of FIR filters using windows -Rectangular, Triangular, Hanning and Blackmann windows.

UNIT-V: APPLICATIONS OF DSP (10 Periods)

Introduction to peripherals - types of physical memory - soft-ware used (Preliminary approach). DSP based control of step-per motors - principle of hybrid stepper motors - basic operation, stepper motor drive system, implementation of stepper-motor control system using LF2407 DSP controller. DSP based implementation of DC-DC buck boost converters - introduction, converter structure, continuous and discontinuous conduction modes, connecting DSP to buck-boost converter, controlling the buck-boost converter.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. A. Anand Kumar, *Digital signal processing*, 2nd Edition, PHI learning Pvt.Ltd, Delhi 2015.
2. Hamid A. Toliyat, Steven G. Campbell, *DSP based electromechanical motion control*, CRC Press Special Indian Edition, 2012.

REFERENCE BOOKS:

1. John G. Proakis, Dimitris G. Manolakis, *Digital Signal Processing, Principles, Algorithms and Applications*, Pearson Education/ PHI, 4th Edition, 2007.
2. Alan.V. Oppenheim, Ronald.W. Schafer, John R Buck, *Discrete Time Signal Processing*, Prentice Hall, 2nd Edition, 2006.

ADDITIONAL LEARNING RESOURCES:

1. https://ocw.mit.edu/resources/res-6-008-digital-signal-processing-spring-2011/
2. https://www.nptel.ac.in/courses/117/102/117102060/
3. https://swayam.gov.in/nd1_noc19_ee50/preview
4. https://www.coursera.org/learn/dsp1

IV B.Tech. I Semester
(19BT70207) SOFT COMPUTING TECHNIQUES
(Professional Elective–5)

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

PRE-REQUISITES: Courses on Basic Mathematics.

COURSE DESCRIPTION: Fundamentals of Artificial Neural Networks, Back propogation Neural Networks, Deep Neural Networks, Fuzzy Logic Systems, Adaptive Neuro Fuzzy Inference Systems, Evolutionary and Swarm algorithms.

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

CO1. develop an architecture of a neural network, its training/learning algorithms and apply them to solve various real world problems.

CO2. develop a rule base fuzzy system and apply the control strategy to control various real world appliances.

CO3. develop an algorithm based on evolutionary principles and model an objective function to optimize the given problem.

CO4. develop an algorithm, mimicking the swarm behaviour of a school and model the objective function to optimize the given problem.

DETAILED SYLLABUS:

UNIT-I: ARTIFICIAL NEURAL NETWORKS (12 Periods)

Biological neural network, architectures of artificial neural networks; Activation functions, learning strategies- supervised, un supervised, reinforced; learning rules; Single layer perceptron network, linear separability with AND & XOR examples; Back propagation neural network- architecture, training algorithm; Kohonen self-organizing maps-competitive process, training algorithm.

UNIT – II: DEEP NEURAL NETWORKS (8 Periods)

Introduction to deep learning, architecture of recurrent neural networks; Back propagation through time; multilayer recurrent networks; Long short-term memory; Regression (load forecasting) and classification (object classification) using neural network.

UNIT – III: FUZZY LOGIC SYSTEMS (10 Periods)

Fuzzy Logic Systems: Classical Vs fuzzy sets, fuzzy relations & operations; Membership functions; Fuzzification; Rule base; Inference mechanism; Defuzzification; Development of fuzzy control system; Speed control of DC motors using fuzzy logic.

UNIT IV – EVOLUTIONARY ALGORITHMS (8 Periods)

Genetic Algorithms: Introduction to evolutionary computation, Genetic algorithms - (GA)biological background, traditional optimization and search techniques, basic terminologies, simple GA, flow chart; Operators in GA - encoding, selection, crossover, mutation, constraints in GA, fitness function; Advantages and limitations of GA.

Differential Evaluation: Overview, initialization, base vector selection, differential mutation, recombination, selection and termination criteria; Optimal allocation of DG.

UNIT V – PARTICLE SWARM OPTIMIZATION (7 Periods)

Introduction to swarm intelligence, the basic PSO method, characteristic features of PSO, PSO algorithm, optimum parameter setting for the best performance of PSO, comparison with other evolutionary computing techniques; MPPT for PV system.

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*, Wiley India private Ltd., 2nd Edition, 2013.
2. Charu C. Aggarwal, *Neural Networks and Deep Learning*, Springer International Publishing AG, part of Springer Nature, 2018

REFERENCE BOOKS:

1. Jacek M. Zurada, *Introduction to Artificial Neural Networks*, Jaico Publishing House.
2. Simon Haykin, *Neural Networks – A Comprehensive Foundation*, Prentice-Hall Inc, 1999.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/117/101/117101055/
2. https://ocw.mit.edu/resources/res-6-007-signals-and-systems-spring-2011/video-lectures/

IV B. Tech. – I Semester

(19BT70208) SMART GRID TECHNOLOGY

(Professional Elective–5)

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

PRE-REQUISITES: A course on Power System Operation and Control.

COURSE DESCRIPTION: Smart grid functions and components; Smart meters and its classification; Demand side management, Communication technology and Cyber security.

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

- CO1. understand the operational and functional aspects of smart grid, architecture and technical challenges.
- CO2. analyze the communication signals from various measuring units and sub-networks for monitoring secured operation adhering relevant standards.
- CO3. assess the various energy options and apply them for the sustainability of Smart grid.
- CO4. develop strategies for demand side management using various communication protocols.
- CO5. understand the challenges and relevant standards in interoperability and cyber security of Smart grid.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO SMART GRID (9 Periods)

Introduction to smart grid as per National Institute Standards and Technology (NIST), smart grid architecture, functions of smart grid components, smart grid initiatives in India, technology drivers and challenges. Overview of the technologies required for smart grid and architecture of smart substation.

NIT-II: SMART GRID MEASUREMENT TECHNOLOGY (9 Periods)

Introduction, standards for information exchange, monitoring, smart meters and measurement technologies, WAMS, PMUs, GIS and google mapping tools and Multi-agent systems technology.

UNIT-III: SUSTAINABLE ENERGY OPTIONS FOR THE SMART GRID (9 Periods)

Renewable Energy Resources, Penetration and Variability Issues Associated with Sustainable Energy Technology, Demand Response Issues, Electric Vehicles and Plug-in Hybrids, Storage Technologies.

UNIT-IV: DEMAND SIDE MANAGEMENT AND COMMUNICATION TECHNOLOGY (9 Periods)

Introduction, Demand Side Management objectives and its classification. Communication technologies: IEEE 802X series. Layouts of Sub-networks: LAN, WAN, NAN, HAN and FAN and its comparison.

UNIT-V: INTEROPERABILITY, STANDARDS AND CYBER SECURITY (9 Periods)
Introduction, State-of-the-Art-Interoperability, Benefits and Challenges of Interoperability, Model for Interoperability in the Smart Grid Environment, Smart Grid Network Interoperability, Interoperability and Control of the Power Grid, Standards, Approach to Smart Grid Interoperability Standards, Smart Grid Cyber Security, Cyber Security State of the Art, Cyber Security Risks, cyber security concerns associated with Advanced Metering Infrastructure, Mitigation approach to cyber security risks.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. James Momoh, *Smart Grid: Fundamentals of design and analysis*, by, John Wiley & sons Inc, IEEE press 2012.
2. Janaka Ekanayake, Nick Jenkins, KithsiriLiyanage, Jianzhong Wu, Akihiko Yokoyama *Smart Grid: Technology and Applications*, John Wiley & sons inc, 2012.

REFERENCE BOOKS:

1. Fereidoon P. Sioshansi, *Smart Grid: Integrating Renewable, Distributed & Efficient Energy*, Academic Press, 2012.
2. Clark W.Gellings, *The smart grid: Enabling energy efficiency and demand response*, Fairmont Press Inc, 2009.

ADDITIONAL LEARNING RESOURCES:

1. NPTEL course: https://nptel.ac.in/courses/108/107/108107113/
2. IEEE Smart grid website : https://smartgrid.ieee.org/resources/webinars

IV B. Tech. – I Semester
(19BT70209) **POWER ELECTRONICS FOR RENEWABLE ENERGY SYSTEMS**
(Professional Elective–5)

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

PRE-REQUISITES: Courses on Electrical Machines-II and Power Electronics.

COURSE DESCRIPTION: Solar Energy Conversion System: Types of Photovoltaic Systems – Stand-alone, Hybrid and Grid Connected Systems; Wind Energy Conversion Systems: Types of WECS — Stand-alone and Grid Connected Systems; Generators in WECS; Power Quality: Issues, standards and problems in distributed generation.

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

CO1. analyze the solar PV system operating in different modes, assess a suitable convertor and control strategies for sustainability of PV system.

CO2. analyze the operation of various electrical machines and review their suitability for wind energy conversion system.

CO3. analyze the operation of various power converters for wind energy conversion system.

CO4. understand various power quality issues and their relevant standards, while mitigating the issues using custom power devices.

DETAILED SYLLABUS:

UNIT-I: POWER CONVERTERS FOR SOLAR APPLICATIONS (9 Periods)
Introduction to solar photovoltaic system; I-V and P-V characteristics; Block diagram of solar photo voltaic system. Principle of operation — line commutated converters (inversion-mode). Selection of inverter. Multilevel inverters and its classification. Battery sizing and array sizing.

UNIT-II: PHOTOVOLTAIC SYSTEMS (11 Periods)
PV Systems — Stand-alone PV system: Charge controllers — series and shunt charge regulators. Maximum power point tracking algorithm. Solar pumping application.
Grid Connected PV Systems: Inverter types — line, self-commutated inverters, PV inverter with high frequency transformer and grid-tied inverter characteristics. Grid connection issues.

UNIT-III: WIND ENERGY CONVERSION SYSTEMS (8 Periods)
Introduction to wind energy system, Components of Wind Energy Conversion System (WECS), classification of WECS, performance of induction generators for WECS; Principle of operation and analysis of induction generator, permanent magnet synchronous generator, squirrel cage and doubly fed induction generators.

UNIT-IV: POWER CONVERTERS FOR WIND APPLICATIONS (9 Periods)

Power converters: Three phase AC voltage controllers, AC-DC-AC converters — uncontrolled rectifiers, PWM inverters, grid interactive inverters, matrix converters. Stand alone operation of fixed and variable speed WECS. Grid connection issues. Grid integrated PMSG and SCIG based WECS.

UNIT-V: POWER QUALITY ISSUES IN RENEWABLE ENERGY INTEGRATION (8 Periods)

Power quality — Definition, Power quality issues, Sources and Effects; International standards of Power quality and Electro Magnetic Compatibility (EMC); Impact of power quality problems in grid integration of renewable energy sources. Power quality enhancement using custom Power devices—STATCOM and DVR.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Mukund R Patel, *Wind and Solar Power Systems*, CRC Press, 2005.
2. Arindam Ghosh, Gerard Ledwich, *Power Quality Enhancement Using Custom Power Devices*, Springer, 2002.

REFERENCE BOOKS:

1. Ion Boldea, *Variable speed generators*, Taylor & Francis group, 2015.
2. Andrzej M. Trzynnadlowski, *Introduction to Modern Power Electronics*, 3rd Edition, wiley India Pvt. Ltd, 2016.
3. Roger C. Dugan, Mark E. Mc. Granaghan, Surya Santosoh and H. Wayne Beaty, *Electrical Power Systems Quality*, Tata McGraw Hill, 3rd Edition, 2012.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/108108078/
2. https://swayam.gov.in/nd1_noc19_ee37/preview
3. https://nptel.ac.in/courses/121/106/121106014/
4. https://nptel.ac.in/courses/103107157/

IV B. Tech. – I Semester
(19BT70231) **POWER ELECTRONICS AND DRIVES LAB**

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

PRE-REQUISITES: Courses on Analog Electronics and Analog Electronics Lab.

COURSE DESCRIPTION: Characteristics of power switching devices; Triggering and commutation circuits of SCR; Working of various power electronics and drives.

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

CO1. analyze the characteristics of various power converters and interpret the practical observations for validation.
CO2. analyze the switching characteristics of power semiconductor devices and select a suitable device for converter circuit.
CO3. analyze rectifier, AC voltage controller and cyclo-converter circuits for R and RL loads operating with different control signals and appropriate drives.
CO4. analyze chopper and inverter circuits for R and RL loads operating with different control signals and appropriate drives.
CO5. work independently or in teams to solve problems with effective communication.

List of Exercises/List of Experiments: Minimum **Ten** experiments are to be conducted.

PART-A: Any six of the experiments to be conducted from the following:

1. Analysis of single and three phase half and full controlled bridge converter for various loads.
2. Analysis of single phase AC voltage controller and cyclo-converter for various loads.
3. Single phase half and full controlled bridge converter with R and RL loads.
4. Single phase dual converter with R and RL loads.
5. Single phase AC voltage controller with R and RL Loads.
6. Single phase cyclo-converter with R and RL loads.
7. Single phase parallel inverter with R and RL loads.

PART-B: Any four of the experiments to be conducted from the following:

8. Speed control of separately excited DC motor using single-phase full converter.
9. Four quadrant chopper fed DC drive.
10. Speed control of single phase induction motor using IGBT based PWM inverter.
11. Speed control of single phase induction motor using cyclo-converter.
12. Analysis of choppers and inverters for various loads using PWM/sliding mode controller.

TEXT BOOKS:

1. L. Ashok Kumar, A. Kalaiarasi and Y. Uma Maheswari, *Power Electronics with MATLAB*, Cambridge University Press, 2017.
2. Narayanaswamy P R Iyer, *Power Electronic Converters – Interactive Modelling Using Simulink*, CRC Press, 2018.

REFERENCE BOOKS:

1. Muhammad H. Rashid, *Power Electronics – Devices, Circuits and Applications*, 4th Edition, Pearson, 2017.
2. Randall Shaffer, *Fundamentals of Power Electronics with MATLAB*, Laxmi Publications, 2nd Edition, 2013.

ADDITIONAL LEARNING RESOURCES:

1. http://vlabs.iitb.ac.in/vlabs-dev/labs/mit_bootcamp/power_electronics/labs/index.php
2. https://www.semicon.sanken-ele.co.jp/en/

IV B. Tech. – I Semester
(19BT70232) **POWER SYSTEM SIMULATION LAB**

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

PRE-REQUISITES: A course on Power systems analysis.

COURSE DESCRIPTION: Investigations on various operational aspects of power system; power flow studies; faults and stability analysis; Power quality issues and its control aspects using simulation tools; FACTS controllers and grid connected PV system.

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

CO1. develop an appropriate simulation program/model to estimate the load profile, schedule the generators and analyze the dynamics of automatic generation control for various operating scenarios.

CO2. develop an appropriate simulation program/model, to model the transmission network and investigate the power flow, fault levels and stability limits for various operating scenarios.

CO3. develop an appropriate simulation/model to simulate various power quality issues and design appropriate filters to mitigate the harmonics.

CO4. develop an appropriate simulation/model to analyze operational aspects of the FACTS controllers for reactive power support and grid connected PV system.

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. Load forecasting using statistical methods.
2. Solving economic load dispatch problem with transmission losses.
3. Simulation of AVR and load frequency control with and without integral controller.
4. Develop bus admittance matrix of a transmission network.
5. Develop bus impedance matrix of a transmission network.
6. Analyze Load flows for a given transmission network.
7. Symmetrical fault analysis using bus impedance matrix.
8. Analysis of rotor dynamics using swing equation.
9. Simulation of power quality problems (Sag/Swell, interruption, transients, harmonics, flickers).
10. Harmonic analysis and Single tuned filter design to mitigate harmonics.
11. Simulation of FACTS controllers (TCR and TCSC).
12. Simulation of single phase grid connected PV system.

REFERENCE BOOKS/LABORATORY MANUALS:

1. Haadi A. Sadat, *Power System Analysis*, McGraw Hill Co. Ltd., India, 2000.
2. Dr. Shailendra Jain, *Modeling and simulation using Matlab simulink*, 2nd Edition Wiley, 2017.
3. *Randall Shaffer, Fundamentals of Power Electronics with Matlab, 1st Edition, Da Vinci Engineering Series, 2007.*
4. https://in.mathworks.com/help/documentation

IV B. Tech. – I Semester
(19BT70233) **INTERNSHIP**

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

PREREQUISITES: -

COURSE DESCRIPTION: Expose students to the industrial environment; Create competent professionals for the industry; sharpen the real time technical / managerial skills required at the job; Gain professional experience and understand engineer‟s responsibilities and ethics; Familiarize with latest equipment, materials and technologies; Gain exposure to technical report writing; Gain exposure to corporate working culture.

COURSE OUTCOMES: After successful completion of 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
(19BT702AC) ELECTRICAL SAFETY AND SAFETY MANAGEMENT
(Audit course)

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

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 and commissioning and maintenance of electrical equipment/plant.

DETAILED SYLLABUS:

UNIT-I: INDIAN ELECTRICITY RULES AND ACTS, AND THEIR SIGNIFICANCE (06 Periods)

OSHA standards of electrical safety, Basic electrical safety rules as per OSHA; Objectives and scope of IE acts and IE rules, Ground clearance and Section Clearances, Clearance in transmission and distribution lines, 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: INTRODUCTION TO ELECTRICAL SAFETY AND SAFETY MANAGEMEN (07 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, Safety precautions in LV installations and electric plant.

UNIT-III: ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS (05 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, safety auditing and economic aspects.

UNIT-IV: ELECTRICAL SAFETY IN HAZARDOUS AREAS (05 Periods)
Hazardous zones—class 0, 1 and 2; Sparks, flashovers and corona discharge in electrical plants; equipment for hazardous locations; scope for live line work, principles of live line maintenance, special tools for live line maintenance, safety instructions for working on HV lines/apparatus.

UNIT-V: SAFETY DURING INSTALLATION, TESTING AND MAINTENANCE (07 Periods)
Safety during installations: Preliminary preparations, preconditions for start of installation work and safe sequence, safety aspects during installations of Transformers and Rotating machines.
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: 30

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. S.Rao, Prof. H.L.Saluja, "*Electrical Safety, Fire Safety Engineering and Safety Management"*, 2nd Edition, Khanna Publishers. New Delhi, 2018 Reprint.

REFERENCE BOOKS:

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

IV B. Tech. – II Semester

(19BT80231) **PROJECT WORK**

Int. Marks	Ext. Marks	Total Marks		L	T	P	C
100	100	200		-	-	-	10

PRE-REQUISITES: -

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 Electrical and Electronic systems 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 Electrical and Electronic and allied problems.

CO3. perform individually or in a team besides communicating effectively in written, oral and graphical forms on Electrical and Electronic systems or processes.

HONORS DEGREE

in

Electrical and Electronics Engineering

(SVEC-19 Regulations)

HONORS DEGREE PROGRAM
IN
ELECTRICAL AND ELECTRONICS ENGINEERING

Honors – (18 Credits) **SIX Theory Courses**

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-I (2 Theory)	19BT50208	Dynamics of Electrical Machines	3	-	-	3	3	40	60	100
	19BT50209	Machine Learning for Electrical Engineering	3	-	-	3	3	40	60	100
	19BT50210	Reactive Power Compensation and Management	3	-	-	3	3	40	60	100
III-II (2 Theory)	19BT60210	Controllers for Power Applications	3	-	-	3	3	40	60	100
	19BT60211	Power Semiconductor Devices and Modeling	3	-	-	3	3	40	60	100
	19BT60212	Power System Reliability	3	-	-	3	3	40	60	100
IV-I (2 Theory)	19BT70210	Digital Control of Power Electronic and Drive Systems	3	-	-	3	3	40	60	100
	19BT70211	Power System Deregulation	3	-	-	3	3	40	60	100
	19BT70212	Power System Security and State Estimation	3	-	-	3	3	40	60	100

Note: If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Honors degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

III B. Tech. – I Semester
(19BT50208) DYNAMICS OF ELECTRICAL MACHINES

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

PRE-REQUISITES: A course on Electrical Machines – II.

COURSE DESCRIPTION: Modelling and analysis of DC, Induction and Synchronous machines in stationary and rotating reference frames.

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

CO1. demonstrate the potential knowledge on magnetically coupled circuits and to model and analyze the performance of Electrical machines to provide feasible solutions.

CO2. apply the knowledge in different types of two pole DC machines and to use appropriate control technique to model DC Machines mathematically.

CO3. apply appropriate transformation technique to obtain reference frame variables and to analyze and design induction machines.

CO4. apply appropriate transformation technique to obtain reference frame variables and to analyze synchronous machines.

DETAILED SYLLABUS:

UNIT - I: BASIC PRINCIPLES OF ELECTRICAL MACHINE ANALYSIS (10 Periods)

Magnetically coupled circuits: Review of basic concepts, magnetizing inductance, modeling linear magnetic circuits. Numerical Problems.

Electromechanical energy conversion: Principles of energy flow, concept of field energy and co-energy. Derivation of torque expression for various machines using the principles of energy flow and the principle of co-energy. Inductance matrices of induction and synchronous machines.

UNIT - II: THEORY OF DC MACHINES (08 Periods)

Basic Two-pole DC machine - Primitive 2-axis machine – Voltage and Current relationship – Torque equation. Mathematical model of separately excited DC motor, DC Series motor and DC shunt motor in state variable form – Transfer function of the motor.

UNIT - III: REFERENCE FRAME THEORY (09 Periods)

Concept of space vector, types of transformation, condition for power invariance, zero-sequence component, expression for power with various types of transformation. Transformations between reference frames: Clarke and Park's Transformations, variables observed from various frames.

UNIT - IV: THEORY OF SYMMETRICAL INDUCTION MACHINES (09 Periods)

Voltage and torque in machine variables, derivation of *dqo* model for a symmetrical induction machine, voltage and torque equation in arbitrary reference frame variables, analysis of steady state operation. State-space model of induction machine in d-*q* variables. Numerical problems.

UNIT - V: THEORY OF SYNCHRONOUS MACHINES (09 Periods)

Equations in arbitrary reference frame. Park's transformation, derivation of *dqo* model for a salient pole synchronous machine with damper windings, torque expression of a salient pole synchronous machine with damper windings and identification of various components. Numerical problems.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Paul C. Krause, Oleg Wasynczuk, Scott D. Sudhoff, *Analysis of Electric Machinery & Drive systems,* IEEE Press, 2002.
2. R. Krishnan, *Electric motor drives, Modeling, Analysis and Control,* Prentice Hall, 2001.

REFERENCE BOOKS:

1. Rik De Doncker, Duco W. J. Pulle, André Veltman, *Advanced Electrical Drives: Analysis, Modeling, Control*, Springer, 2011.
2. A.E. Fitzgerald, Charles Kingsley, Stephen D. Umans, *Electric Machinery*, TMH, 5th Edition, 2003.

III B. Tech. - I Semester
(19BT50209) **MACHINE LEARNING FOR ELECTRICAL ENGINEERING**

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, Electrical machines, Electrical power systems.

COURSE DESCRIPTION: Types of machine learning, data preprocessing, model selection, Bayes theorem, Supervised learning, classification algorithms, Neural network-activation functions, architectures, Back propagation, Regression algorithms, Clustering techniques, Recurrent neural network- Long Short-Term Memory(LSTM), Gated Recurrent Unit(GRU), Restricted Boltzmann Machine, applications.

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

CO1. demonstrate knowledge on machine learning techniques, concepts of model selection and training strategies.

CO2. analyze suitable machine learning algorithm for various types of learning tasks.

CO3. design an efficient recurrent Neural Network architecture to model patterns of a given learning problem.

CO4. select and apply machine learning algorithm to solve problems such as load forecasting, fault detection and speed control of motor.

DETAILED SYLLABUS:

UNIT–I: FUNDAMENTALS OF MACHINE LEARNING (09 Periods)

Introduction to machine learning, Types of machine learning- Supervised, Unsupervised and Reinforcement and its comparison; applications of machine learning; Data pre-processing, selecting a model, training a model, Model representation and interpretability.

UNIT–II: SUPERVISED LEARNING: CLASSIFICATION AND BASICS OF NEURAL NETWORK (10 Periods)

Introduction to Supervised learning; classification model, classification learning steps, classification algorithms- Introduction to Bayes theorem, Bayes theorem concept learning-Naïve Bayes classifier and its steps, k-Nearest Neighbour, Decision tree, Support Vector Machine.

Introduction to neural network, biological & artificial neuron, types of activation functions; Implementations of ANN-McCulloch-pitts model, multi-layer perceptron, architectures of NN; Backpropagation, study of backpropagation neural network algorithm for speed control of a motor and fault location in transmission lines.

UNIT–III: SUPERVISED LEARNING: REGRESSION (08 Periods)

Introduction to regression, regression algorithms-simple linear regression, multiple linear regression-assumptions, methods to improve the accuracy of linear regression model, polynomial regression model, logistic regression, maximum likelihood estimation, study of machine learning algorithm for speed control of a motor.

UNIT–IV: UNSUPERVISED LEARNING **(9 Periods)**

Introduction to unsupervised learning, unsupervised vs supervised learning, applications of unsupervised learning, clustering-clustering as a machine learning task, different types of clustering techniques; partitioning methods, k-means-a centroid-based technique, Elbow method, K-Medoids: a representative object based technique, hierarchical clustering, density based method, association rule, pattern finding using association rule, algorithm for association rule, build the apriori principle rules; study of machine learning algorithm for optimal allocation of Distributed Generation(DG).

UNIT–V: DEEP LEARNING **(9 Periods)**

Introduction to deep learning and Recurrent Neural Network(RNN), architecture of simple RNN, training a Recurrent Neural Network , RNN topology, challenges with vanishing gradients, bidirectional and stateful RNN's; Long Short-Term Memory (LSTM), Gated Recurrent Unit(GRU), deep recurrent neural network, Restricted Boltzmann Machine-architecture, energy based model; Application of RNN for short term load forecasting.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Saikat Dutt, Subramanian Chandramouli and Amit Kumar Das, "*Machine Learning*", Pearson Publications, 5th Edition, 2020.
2. Dr.S.Lovelyn Rose, Dr.L.Ashok Kumar and Dr.D.Karthika Renuka, "*Deep Learning using PYTHON*", Wiley Publications, 1st Edition, 2019.

REFERENCE BOOKS:

1. Charu C.Aggarwal "*Neural Networks and Deep learning*" Springer International Publishing, 2018.
2. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press, 4thEdition, 2020.

ADDITIONAL LEARNING RESOURCES:

1. (Pdf) Application Of Backpropagation Neural Network For Fault Location In Transmission Line 150 Kv (researchgate.net)
2. https://www.ijert.org/research/dc-motor-speed-control-using-machine-learning-algorithm
3. https://www.sciencedirect.com/science/article/pii/S1877050915020074
4. https://www.sciencedirect.com/science/article/pii/S1876610219310008

III B. Tech. – I Semester
(19BT50210) REACTIVE POWER COMPENSATION AND MANAGEMENT

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

PRE-REQUISITES: A course on Power system operation and control.

COURSE DESCRIPTION: Reactive Power Compensation, Types of Compensations, Reactive Power Management in Demand Side, Distribution Side & Domestic and Industrial Sectors

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

CO1. understand the significance of reactive power compensation in power system network and asses an appropriate compensation technique for different scenarios.

CO2. analyze transmission network models for coordinating reactive power and asses quality of power supply for various operating conditions.

CO3. analyze demand and distribution side management principles, and apply suitable reactive power management utilities for technical and economic benefits.

CO4. apply the principles of reactive power management for various domestic and industrial applications.

DETAILED SYLLABUS:

UNIT-I: REACTIVE POWER COMPENSATION (10 Periods)

Introduction, Importance of reactive power control in EPS. Requirement for compensation, Objectives in load compensation, Specifications of a load compensator, Power factor correction and voltage regulations in single phase system, Phase balancing and p. f. correction of unsymmetrical loads, Compensation in terms of symmetrical components.

UNIT-II: TYPES OF COMPENSATIONS (10 Periods)

Introduction- Uncompensated line – types of compensation – Passive shunt and series and dynamic shunt compensation –Uniformly distributed fixed compensation, Passive shunt compensation- Objectives. Series compensation: Objectives and practical limitations, series capacitor and shunt reactor, Advantages & disadvantages of Passive and active compensators.

UNIT-III: REACTIVE POWER COORDINATION (08 Periods)

Objective – Mathematical modeling – Operation planning – transmission benefits – Basic concepts of quality of power supply – disturbances- steady –state variations – effects of under voltages – frequency – Harmonics, radio frequency and electromagnetic interferences.

UNIT-IV: REACTIVE POWER MANAGEMENT (09 Periods)

Demand side management - load patterns, load shaping, power tariffs, kVAR based tariffs, penalties for voltage flickers and harmonic voltage levels.

Distribution side management - system losses, loss reduction methods, Reactive power planning in distribution systems - objectives, economics planning for capacitor placement and retrofitting of capacitor banks.

UNIT-V: REACTIVE POWER MANAGEMENT FOR DOMESTIC AND INDUSTRIAL APPLICATIONS (08 Periods)

kVAR requirements for domestic appliance - purpose of using capacitors, selection of capacitors, deciding factors, characteristics and limitations. Typical layout of traction systems – reactive power control requirements. Electric arc furnaces. Textile and plastic industries. Furnace transformer. Filter requirements, remedial measures and power factor of an arc furnace.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. T.J.E.Miller, *Reactive power control in Electric power systems*, A Wiley–Inter science publications, New York, 1982.
2. D.M. Tagare, *Reactive power Management*, Tata McGraw-hill publishing company Ltd., New Delhi, 2004.

REFERENCE BOOKS:

1. C.L.Wadhwa, *Electrical Power Systems*, New age Interna tional, New Delhi, 5th Edition, 2009.
2. Wolfgang Hofmann, Jurgen Schlabbach, Wolfgang Just "*Reactive Power Compensation: A Practical Guide*", Wiely publication, April, 2012.

ADDITIONAL LEARNING RESOURCES:

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

III B. Tech. – II Semester
(19BT60210) **CONTROLLERS FOR POWER APPLICATIONS**

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

PRE-REQUISITES: A course on Control systems.

COURSE DESCRIPTION: Construction, types, switching, operating characteristics and applications of power semiconductor devices; Design of firing, protective circuits and heat sinks for various power semiconductor devices.

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

CO1. design a classical controller for controlling a system by applying the principles of classical control theory.
CO2. analyze dynamics of a system and design an appropriate sliding mode controller by applying the principles of sliding mode control.
CO3. analyze dynamics of a system and develop an appropriate Variable Structure controller by applying the principles of variable structure controller.
CO4. design an appropriate Hysteresis current control and Predictive current controller for a given system.
CO5. design an appropriate H-infinity and robust controller for a given system.

DETAILED SYLLABUS:

UNIT-I: CLASSICAL CONTROLLER DESIGN (08 Periods)
Introduction to classical Controller—Proportional (P), Integral (I), Derivative (D), PI-PD, PID Controllers; Characteristics, Design Controller; Tuning— Ziegler-Nichol's method and Cohencoon method, Damped oscillation method.

UNIT-II: SLIDING MODE CONTROL (09 Periods)
Dynamics in the sliding mode – linear system, non-linear system, chattering phenomenon; sliding mode control design – reachability condition, robustness properties application; Sliding Surfaces, Continuous approximations of Switching Control laws, Modeling/Performance.

UNIT-III: VARIABLE STRUCTURE CONTROLLER (10 Periods)
Variable Structure Systems (VSS)-Introduction- Synthesis of stable systems from unstable structures- VSS for improving speed of response,-VSS for stability Basic Concepts, Theory, and Methods.

UNIT-IV: HYSTERESIS CURRENT CONTROL (08 Periods)
Hysteresis current control (HCC) – Design of HCC with PWM schemes Predictive current controller (PCC) –Model predictive control (MPC)-PWM predictive control (PPC).

UNIT-V: H-INFINITY AND ROBUST CONTROL THEORY (10 Periods)
Instruction of H-infinity methods in control theory-Elements of Robust Control Theory –

Design Objectives – Shaping the Loop Gain –Signal Spaces – Computation of H-norm- All Pass Systems-- Linear-quadratic-Gaussian control (LQG); Robust Control Theory- Robust Controller Design- Robust decision methods- Analytic tools for robust decision making.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Jean Pierre Barbot," *Sliding Mode Control in Engineering*" Marcel Bekker, 2002.
2. Zinober, Alan S.I., ed.1994 "*Variable Structure and Lyapunov Control*", London: Springer-Verlag.

REFERENCE BOOKS:

1. Chandrasekharan P.C., "*Robust Control of Linear Dynamical Systems*" , Academic Press Limited, San Diego.1996.
2. SomanathMajhi., "*Advanced Control Theory A relay Feedback Approach*", CengageLearning, 2009.

III B. Tech. – II Semester
(19BT60211) **POWER SEMICONDUCTOR DEVICES AND MODELING**

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

PRE-REQUISITES: A course on Electronic Devices & Circuits.

COURSE DESCRIPTION: Construction, types, operating characteristics and applications of power semiconductor devices; Modeling of power semiconductor devices and heat sinks for various power semiconductor devices.

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

CO1. understand the principle characteristics of power switching devices, while confronting for various power converters.

CO2. analyze various power diodes and thyristors operating in sustainable modes of operation and determine their operational characteristics.

CO3. analyze various transistors operating in sustainable modes of operation and determine their operational characteristics.

CO4. analyze various special power devices operating in sustainable modes of operation and determine their operational characteristics.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION TO POWER SWITCHING DEVICES (08 Periods)
Status of development of power semiconductor devices, types of static switches — controlled and uncontrolled, application requirements, circuit symbols and ratings; Characteristics of an ideal and practical switches; Device selection strategy; Concept of on-state and switching losses; Electro Magnetic Interference (EMI) due to switching; Power handling capability — Safe Operating Area (SOA); Heat sink — Thermal resistance and specifications.

UNIT-II: SPICE MODELLING (09 Periods)
Circuit Descriptions, defining output variables — DC and AC analysis, voltage and current sources, passive elements and Dot commands.
Power Diode — static diode model, characteristics and diode parameters; Modeling of diode rectifiers — single phase and three phase diode rectifiers.

UNIT-III: THYRISTOR MODELLING AND APPLICATIONS (09 Periods)
Static thyristor model, characteristics and thyristor parameters; Thyristor mounting techniques and improvements of thyristor ratings; Modeling of controlled rectifiers — single and three phase controlled rectifiers. Modeling of single phase AC voltage controllers and cyclo-converters.

UNIT-IV: TRANSISTOR MODELLING AND APPLICATIONS (10 Periods)
Bipolar Junction Transistor (BJT), Metal Oxide Field Effect Transistor (MOSFET) and Insulated Gate Bipolar Transistor (IGBT): Static model, characteristics and parameters; Modeling of buck, buck-boost chopper using BJT; Modeling of boost and cuk chopper using MOSFET.

UNIT-V: SPECIAL POWER DEVICES **(09 Periods)**

Thyristors: GTOs — construction, operation, steady state characteristics, switching characteristics and static SPICE model. Construction and operation: BCTs, TRIAC, FET–CTHs, ETOs, IGCTs, MCTs, SITHs, ASCR, RCT, SCS and light activated thyristor. Comparison of various thyristors.

Transistors: Construction and operation — COOLMOS and SITs.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Muhammad H. Rashid, *Power Electronics: Circuits, Devices and Applications*, Pearson Education, 4th Edition, 2014.
2. Muhammad H. Rashid, *SPICE for Power Electronics and Electric Power*, CRC Press, 3rd Edition, 2012.

REFERENCE BOOKS:

1. M. D. Singh & K. B. Kanchandhani, *Power Electronics*, Tata McGraw – Hill Publishing Company, 3rd Edition, 2008.
2. Dr. P. S. Bimbhra, *Power Electronics*, Khanna Publishers, New Delhi, 4th Edition, 2012.

ADDITIONAL LEARNING RESOURCES:

1. https://nptel.ac.in/courses/117106033/
2. https://nptel.ac.in/courses/117106033/19

III B. Tech. – II Semester
(19BT60212) POWER SYSTEM RELIABILITY

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

PRE-REQUISITES: Courses on Engineering mathematics and Power Systems Analysis.

COURSE DESCRIPTION: Fundamentals of Reliability Engineering; Reliability Functions and Network Modelling; Evaluation of Generation System Reliability Analysis; Evaluation of Frequency and Duration Techniques; Evaluation of Power Distribution System Reliability Analysis

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

CO1. apply the relevant probability techniques in analyzing, designing and evaluating the various network configurations for reliability indices.

CO2. evaluate cumulative probability and frequency indices of a power system using Markov techniques.

CO3. apply the relevant reliability engineering techniques in evaluating the generation system reliability indices with merged load models and follow the relevant professional standards.

CO4. apply conceptual knowledge of reliability networks in solving power distribution system reliability indices and follow the relevant professional standards.

DETAILED SYLLABUS:

UNIT-I: FUNDAMENTALS OF RELIABILITY ENGINEERING (10 Periods)

Probability Concept, Random variables, Probability Density and Distribution function. Mean, SD, Variance, types of Failures, Reliability cost and worth.

Probability Distributions:

Continuous distributions - Exponential distribution, weibull distribution and normal distribution - mean, standard deviation, variance. Discrete distributions - binomial distribution, Poisson distribution.

UNIT–II: RELIABILITY FUNCTIONSAND NETWORK MODELLING (10 Periods)

Reliability functions f(t), F(t), R(t), λ(t) and their relationships, bath tub curve. Reliability measures - MTTF, MTTR, MTBF. Reliability economics. Reliability block diagrams – series, parallel systems and combined series-parallel systems. Reliability analysis of series parallel networks using exponential distribution. Reliability evaluation of non-series-parallel systems - decomposition method, cut-set and tie-set method. Concept of redundancy – standby redundant systems.

UNIT–III: GENERATION SYSTEM RELIABILITY ANALYSIS (08 Periods)

Introduction – Generation system model – determination of capacity outage probability table – Identical units – Non-Identical units – Determination of transitional rates – deterministic and probabilistic criteria – Sequential addition method – Recursive relation for unit addition, unit removal - LOLP, LOLE, LOEE, EIR.

UNIT–IV: FREQUENCY AND DURATION TECHNIQUES (10 Periods)

Markov chain–concept of stochastic transitional probability matrix (STPM), evaluation of limiting state probabilities. Markov processes - time dependent probability evaluation – evaluation of limiting state probabilities using STPM – one, two component repairable models. Frequency and duration concept – evaluation of frequency of encountering state for one, two component repairable models – evaluation of cumulative probability and cumulative frequency of encountering of merged states for power systems.

UNIT–V: DISTRIBUTION SYSTEM RELIABILITY ANALYSIS (07 Periods)

Distribution system reliability analysis - radial networks – evaluation of basic reliability indices, performance indices – customer oriented, load and energy oriented indices and application to radial systems- effect of lateral distributor protection, disconnects and protection failure.

Total Periods: 45

Topics for Self-study are provided in the Lesson Plan

TEXTBOOKS:

1. Roy Billinton and Ronald N Allen, *Reliability Evaluation of Power Systems*, 2nd Edition, Springer, New York, 1996.
2. J. Endrenyi, *Reliability Modelling in Electric Power Systems*, 1st Edition, John Willey and Sons, US, 1978.

REFERENCES:

1. Roy Billintonand Ronald N Allen, *Reliability Evaluation of Engineering Systems*, 2nd Edition, Springer, NewYork, 2013.
2. CharlesE. Ebeling, *An Introduction to Reliability and Maintainability Engineering*, Tata McGraw Hill, India, 2004.
3. V. Sankar, *System Reliability Concepts*, Himalaya Publishing House, 1st Edition, 2015.

IV B.Tech. –I Semester
(19BT70210) DIGITAL CONTROL OF POWER ELECTRONICS AND DRIVE SYSTEMS

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

PRE-REQUISITES: Courses on Power Electronics and Solid State Drives.

COURSE DESCREPTION: Peripherals; Memory addressing modes; DSP based control of DC-DC converters; DSP based control of matrix converters; DSP based control of PMBLDC and SRM drives.

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

CO1. comprehend various addressing modes of LF2407 processor and its instruction sets.
CO2. develop simple and complex programs to control power electronic circuits using LF2407 processor.
CO3. apply the Pulse width modulation techniques to control inverter fed AC drives and to implement them using LF2407 processor.
CO4. design controller for PMBLDC and SRM drives using LF2407 processor.

DETAILED SYLLABUS:

Unit-I: Motor Control Signal Processors (09 Periods)
Introduction - Brief Introduction to Peripherals - Types of Physical Memory - The Components of the C2xx DSP Core - System configuration registers-Memory Addressing modes - Instruction set – Programming techniques – simple programs.

Unit-II: Peripherals of Signal Processors (09 Periods)
General purpose Input/output (GPIO) Functionality- Interrupts - A/D converter-Event Managers (EVA, EVB) - PWM signal generation.

Unit-III: DSP-Based Control of DC-DC Converters (09 Periods)
Introduction- Converter Structure-Continuous Conduction Mode, Discontinuous Conduction Mode- Connecting the DSP to the Buck-Boost Converter- Controlling the Buck-Boost Converter-Main Assembly Section Code Description Interrupt Service Routine. The regulation Code Sequences.

Unit-IV: DSP-Based Control of Matrix Converters (09 Periods)
Pulse Width Modulation- Principle of Constant V/F Control for Induction Motors- SVPWM Technique- DSP Implementation- Introduction to matrix converter-Topology and Characteristics- Control Algorithms- Bidirectional Switch-Current Commutation - Overall Structure of Three-Phase Matrix Converter-Implementation of the Venturini Algorithm using the LF2407.

Unit-V: DSP-Based Control of PMBLDC and SRM Drives (09 Periods)
Control of PMBLDC motor drives: Introduction-Principles of the BLDC Motor- Torque Generation -BLDC Motor Control System Implementation of the BLDC Motor Control

System Using LF2407.Control of SRM drives: Introduction-Fundamentals of Operation-Fundamentals of Control in SRM Drives- Open Loop Control Strategy for Torque- Closed Loop Torque Control of the SRM Drive.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Hamid A.Toliyat, Steven Campbell, *DSP based electromechanical motion control*, CRC Press, Special Indian Edition.

REFERENCE BOOKS:

1. R.Krishnan*, Electric Motor Drives – Modeling, Analysis and Control,* Prentice-Hall of India Pvt. Ltd., New Delhi, 2010
2. T.Kenjo and S.Nagamori*, Permanent magnet and Brushless DC motors,* Clarendon press, London, 1988.

IV B. Tech. – I Semester
(19BT70211) **POWER SYSTEM DEREGULATION**

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

PRE-REQUISITES: A course on Power system Operation and Control.

COURSE DESCRIPTION: Features of Restructured Power systems; Market models; Information and transmission services; Electricity pricing and forecasting; Ancillary services management.

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

- CO1. understand the functioning of various market models and the role of power exchange in coordinating various entities of deregulated power system.
- CO2. realize the operation of various entities in various time horizons and the market modes to provide necessary ancillary services for sustainable operation of power system.
- CO3. realize the role of OASIS system functionalities and determine various transmission capabilities of transmission lines.
- CO4. realize various pricing models for trading electricity and methods of forecasting the price and load in competitive market.
- CO5. realize the necessary ancillary services required for maintaining secured operation of restructured power system.

DETAILED SYLLABUS:

Unit - I: OVERVIEW OF KEY ISSUES IN ELECTRIC UTILITIES (08 Periods)
Introduction: Deregulation, need for deregulation, Advantages of deregulation in power system. Restructuring Models: PoolCo Model, Bilateral Model, Hybrid Model: independent system operator (ISO), Role of ISO. Power exchange, market operations, market power, standard cost, transmission pricing, congestion pricing and management of congestion.

Unit - II: MARKET MODELS IN RESTRICTED POWER SYSTEMS (08 Periods)
Introduction: Market models based on contractual arrangements: Monopoly model, Single buyer model, Wholesale competition model, Retail competition model. Comparison of various market models. Market architecture: Day-ahead and Hour-Ahead Markets, Block forwards Market, Transmission Congestion Contracts (TCCs), and Ancillary service market.

Unit - III: OASIS: OPEN ACCESS SAME-TIME INFORMATION SYSTEM (09 Periods)
Structure of OASIS: Functionality and Architecture of OASIS, information requirement of OASIS, Transfer Capability on OASIS: Definitions, Transfer Capability Issues, ATC Calculation, TTC Calculation, TRM Calculation, CBM Calculation. Transmission Services, Methodologies to Calculate ATC.

Unit - IV: ELECTRICITY PRICING - VOLATILITY, RISK AND FORECASTING (10 Periods)

Electricity pricing: introduction, electricity price volatility, electricity price indexes. Challenges to Electricity Pricing: Pricing Models, Reliable Forward Curves. Construction of Forward Price Curves: Time frame for Price Curves, Types of Forward Price Curves: Short term Price Forecasting, Factors Impacting Electricity Price, Forecasting Methods, Analyzing Forecasting Errors.

Unit - V: ANCILLARY SERVICES MANAGEMENT (08 Periods)

Introduction: Types of ancillary services, Classification of ancillary services, Load-generation balancing related services: Frequency regulation, Load following, Spinning reserve services. Voltage control and reactive power support services: Generators, Synchronous condensers, Capacitors and inductors, SVCs, STATCOMs- Black start capability service.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Kankan Bhattacharya, Math H.J. Buller, Jalap E. Daladier, *Operation of Restructured Power System*, Kluwer Academic Publisher, 2001.
2. Mohammad Shahidehpour, and Muwaffaq Alomoush, - *Restructured Electrical Power Systems – Operation, Trading and Volatility,* Marcel Dekker, Inc. 2001.

REFERENCE BOOK:

1. Loi Lei Lai, *Power system Restructuring and Deregulation*, John Wiley & Sons Ltd., England, 2001.

IV B. Tech. – I Semester
(19BT70212) **POWER SYSTEM SECURITY AND STATE ESTIMATION**

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

PRE-REQUISITES: A course on Power System Analysis.

COURSE DESCRIPTION: Power system network matrices; Balanced and unbalanced short circuit analysis; AC and DC Load flow studies; Power system security; Power system state estimation.

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

- CO1. develop mathematical models of the power system for various power system studies.
- CO2. apply knowledge of power system network matrices to solve various faults in power system.
- CO3. apply knowledge of power system network matrices to evaluate the security of the power system.
- CO4. apply knowledge of power system network matrices to estimate the state of power system.

DETAILED SYLLABUS:

UNIT-I: POWER SYSTEM NETWORK MATRICES (08 Periods)

Formation of bus admittance matrices by direct inspection method and singular transformation method; Algorithm for formation of Bus impedance matrix; Sparsity programming and Optimal Ordering – numerical problems. ∏-representation of off-nominal tap transformers.

UNIT-II: FAULT ANALYSIS (09 Periods)

Short circuit studies – introduction, short circuit calculations using Z_{bus}, Z_f^{abc}, Y_f^{abc}, Z_f^{012} and Y_f^{012} matrices for various faults. Analysis of balanced and unbalanced three phase faults – Numerical problems.

UNIT-III: POWER SYSTEM SECURITY-I (08 Periods)

Review of power flow methods (qualitative treatment only), DC power flow method-Numerical problems. Introduction to power system security, factors influencing power system security.

UNIT-IV: POWER SYSTEM SECURITY-II (10 Periods)

Introduction to contingency analysis, Contingency analysis: Detection of Network problems, linear sensitivity factors, AC power flow methods, Contingency selection–Numerical problems

UNIT-V: STATE ESTIMATION IN POWER SYSTEM (10 Periods)

Power system state estimation, SCADA, EMS center, Methods of state estimation – method of least squares, orthogonal matrix, properties, Givens rotation, orthogonal decomposition, Bad data detection, and applications of power system state estimation – Numerical problems.

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Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Allen J. Wood and Wollenberg B.F., *Power Generation Operation and control*, 2nd Edition, John Wiley & Sons, 2006.
2. P. Venkatesh, B.V. Manikandan, S. Charles Raja and A.Srinivasan, *Electrical power systems analysis, security, and deregulation*, PHI learning private limited, Delhi, 2014.

REFERENCE BOOKS:

1. Nagrath I.J. and Kothari D.P., *Modern Power System Analysis*, TMH, New Delhi, 2004.
2. John J. Grainger and William D. Stevenson, *Power System Analysis*, Tata McGraw-Hill, 2003

MINOR DEGREE

(SVEC-19 Regulations)

MINOR DEGREE IN

ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING

Offering Department: Computer Science and Engineering
Students of Eligible Branches: EEE, ECE, 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 the respective course.

III B. Tech. – I Semester

(19BT50502) **ARTIFICIAL INTELLIGENCE**

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

PRE-REQUISITES: --

COURSE DESCRIPTION: Introduction to artificial intelligence, Designing intelligent agents, Solving general purpose problems, Search in complex environments, Probabilistic reasoning, Represent knowledge and reason under uncertainty, Robotics, Ethics and safety in AI.

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

CO1. Architect intelligent agents using artificial intelligence techniques and principles.

CO2. Analyze and interpret the problem, identify suitable solutions using heuristic functions, optimization algorithms and search algorithms.

CO3. Select and apply appropriate knowledge representation to build Bayesian network models to reason under uncertainty.

CO4. Investigate robot hardware and frameworks for intelligent robotic perception.

CO5. Demonstrate knowledge on ethical implications of intelligent machines for providing privacy, trust, security and safety.

DETAILED SYLLABUS:

UNIT–I: INTRODUCTION TO ARTIFICIAL INTELLIGENCE (10 Periods)
Foundations of artificial intelligence, History of artificial intelligence, State of the art, Risks and benefits of AI, Intelligent agents – Agents and environments, The concept of rationality, Structure of agents.

UNIT–II: PROBLEM SOLVING BY SEARCHING (9 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 (9 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 (9 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 (8 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 (8 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 (9 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

(7 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 (8 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 (8 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 (9 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:

1. Python 3.8
2. Python Libraries – NumPy, Pandas, Matplotlib,
3. 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 (9 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 (9 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 (8 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 (8 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: A course on "Differential Equations and Multivariable Calculus".

COURSE DESCRIPTION: Optimization, Classical optimization techniques, Nature inspired algorithms, Genetic algorithm, Particle swarm optimization, Ant colony optimization, Bee colony optimization, Cuckoo search algorithm, Firefly algorithm, Bat algorithm, Gray wolf optimization, Elephant herding optimization, Applications of nature inspired algorithms.

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

CO1. Demonstrate knowledge on optimization and classical optimization techniques to find optimal solutions for a given problem.

CO2. Analyze the key components and mathematical aspects of nature inspired algorithms.

CO3. Design efficient solutions for optimization problems using nature inspired algorithms.

CO4. Investigate the applications of nature inspired algorithms to solve wide range of optimization problems.

DETAILED SYLLABUS:

UNIT–I: INTRODUCTION TO OPTIMIZATION (9 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 (8 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 (9 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 (9 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 the 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 (9 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 (9 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 (9 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 **(8 Periods)**

Instance Based Learning: k-Nearest Neighbor learning, Locally weighted regression, Radial basis functions, Case-based reasoning.

Reinforcement Learning: The learning task, Q-learning, Nondeterministic rewards and actions, Temporal difference learning, Generalizing from examples, Relationship to dynamic programming.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Tom M. Mitchell, *Machine Learning*, McGraw Hill, 2013.
2. Kevin P. Murphy, *Machine Learning*: *A Probabilistic Perspective*, MIT Press, 2012.

REFERENCE BOOKS:

1. Ethem Alpaydin, *Introduction to Machine Learning*, MIT Press, 4^{th} 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: Courses on “Programming for Problem Solving”, “Machine Learning”.

COURSE DESCRIPTION: Implementation of Back propagation algorithm, Decision tree learning, Neural networks, k-NN from scratch algorithm, Naïve Bayes classifier, Radial basis function neural network, SVM based classifier, Maximum likelihood estimation using statistical techniques.

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

CO1. Analyze the given problem and identify appropriate machine learning technique to provide an intelligent solution.

CO2. Design and implement machine learning solutions for classification, regression, and clustering problems.

CO3. Develop intelligent solutions to solve societal problems related to computer vision, information security, healthcare and other areas.

CO4. Work independently to solve problems with effective communication.

LIST OF EXERCISES:

1. Solve classification problem by constructing a feedforward neural network using Backpropagation algorithm. (Wheat Seed Data)
2. Implement ID3 (information gain) algorithm for decision tree learning for transforming continuous variables into discrete variables.
3. Explore the problem of overfitting in decision tree and develop solution using pruning technique.
4. Build a neural network that will read the image of a digit and correctly identify the number.
5. Implement k-NN algorithm to solve classification problem.
6. Use Naïve Bayes classifier to solve the credit card fraud detection problem over a skewed dataset.
7. Design and implement a radial basis function neural network to solve function approximation or regression problem.
8. Compare and analyze the performance of optimal Bayes classifier and Naïve Bayes using simulated Gaussian Data.

9. Train an SVM based classifier to predict whether the cancer is malignant or benign.
10. Solve the stock price forecasting problem using statistical techniques – Maximum Likelihood estimation after understanding the distribution of the data.

REFERENCE BOOKS:

1. Sebastian Raschka, Vahid Mirjalili, *Python Machine Learning*, Packt Publishing, 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:

1. Python
2. Scikit-learn/Keras/TensorFlow

ADDITIONAL LEARNING RESOURCES:

1. https://www.coursera.org/learn/machine-learning
2. https://nptel.ac.in/courses/106106202/

IV B. Tech. – I Semester

(19BT71503) **DEEP LEARNING**

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

PRE-REQUISITES: A course on "Machine Learning"

COURSE DESCRIPTION: Overview of machine learning; Fundamentals of deep learning; Modern approaches in deep learning; Feedforward neural network architectures; Deep learning Models and Applications.

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

CO1. Analyze a neural network by applying the basics of mathematics and machine learning.

CO2. Analyze the data using multilayer perceptron and backpropagation algorithms.

CO3. Apply regularization and optimization techniques to improve the performance of Deep neural networks.

CO4. Identify appropriate deep learning model for text, multimedia, and biological data analysis.

CO5. Compare deep neural networks and deep learning models to infer the suitable learning algorithm on large scale data.

CO6. Develop a model for domain specific applications by applying various network models in deep learning.

DETAILED SYLLABUS:

UNIT-I: INTRODUCTION (9 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 (9 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 (9 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 (8 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, the students will be 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:

1. Environment: Google CoLab
2. Programming Language: Python 3.8
3. Machine Learning Library: Tensor Flow 2.1 and Keras

ADDITIONAL LEARNING RESOURCES:

1. Bharath Ramsundar, Reza Bosagh Zadeh, *TensorFlow for Deep Learning,* O'reilly, 2018.
2. https://www.coursera.org/professional-certificates/tensorflow-in-practice
3. https://www.coursera.org/learn/introduction-tensorflow

MINOR DEGREE IN

INTERNET OF THINGS

Offering Department: INFORMATION TECHNOLOGY
Students of Eligible Branches: CSE, CSSE, EEE, ECE, 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 SOFTWARE DEVELOPMENT TOOLS: Host and Target machines, Linker/Locators for Embedded Software, Getting Embedded Software into the Target System; Debugging Techniques: Testing on Host Machine.

UNIT-V: INTRODUCTION TO ADVANCED ARCHITECTURES (08 Periods)

ARM and SHARC, Processor and memory organization and Instruction level parallelism; Networked embedded systems: Bus protocols, I2C bus and CAN bus.

Total Periods: 45

Topics for self-study are provided in the 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: (9 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: (9 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: (9 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: **(8 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 the 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 students 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: (9 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: (9 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: **(9 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: **(9 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 **(9 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 the 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 (9 Periods)
Introduction, Characteristics of Cloud Computing. Cloud Models, Cloud Services Examples, Cloud-based Services and Applications.

UNIT-II: (9 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 (9 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 (9 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 (9 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 the 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 I– INTRODUCTION: SECURING THE INTERNET OF THINGS (9 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 (9 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 (9 Periods)
Identity lifecycle, authentication credentials, IoT IAM infrastructure; Authorization with Publish/Subscribe schemes; access control.

UNIT IV – PRIVACY PRESERVATION AND TRUST MODELS FOR IoT (9 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 **(9 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: A Course on Internet of Things Lab.

COURSE DESCRIPTION: Packet Switching Terminology, Traditional Switch architecture, Fundamental Characteristics of SDN, SDN Controller, SDN Applications, SDN in the data center**,** Use Cases in the Data Center, Scope of the Internet of Things, SDN for IoT.

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

CO1. Demonstrate knowledge on characteristics of Data center and Network Technologies.

CO2. Demonstrate skills on Operating and performing Data flow in Software Defined Networks

CO3. Identify suitable Data Center topologies for virtualized environment.

CO4. Apply Software defined Networks concepts for the Internet of Things

CO5. Apply suitable addressing schemes and routing protocols to achieve QoS in SDN based IoT.

DETAILED SYLLABUS:

UNIT- I: INTRODUCTION TO SOFTWARE DEFINED NETWORKS (9 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 (9 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 (9 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 (9 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: **(9 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 the 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

DETAILED SYLLABUS:

UNIT-I: (9 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: (9 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: (9 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: (9 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: (9 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 and Big Data Analytics, Sensors And Tools of IoT Analytics, Services of IoT, Big Data Storage Systems for IoT, Case Studies and Applications of IoT

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

CO1. Use Analytical Architecture and its exploration in Data Analytics for IoT

CO2. Analyze and Visualize the Sensor data for IoT.

CO3. Apply Advanced Analytical Architectures as a service for IoT.

CO4. Analyze Big data storage systems in IoT.

CO5. Develop Real Time solutions for given societal problems.

DETAILED SYLLABUS:

UNIT-I: **INTRODUCING IoT ANALYTICS (9 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 (9 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 (9 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 (9 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 the lesson plan.

TEXT BOOKS:

1. John Soldatos, *Building Blocks for IoT Analytics*, River Publishers, 2017.
2. Pethuru Raj, T. Poongodi, Balamurugan Balusamy, and Manju Khari*, Internet of Things and Big Data Analytics Integrated Platforms and Industry Use Cases*, 1^{st} 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: EEE, ECE, 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	Ad hoc 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 (9 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 (9 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 (9 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 (9 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 **(9 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(S):

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
(19BT60541) AD HOC 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 (8 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 (8 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 (9 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 (9 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 the 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:

1. https://www.tyndall.ie/wireless-sensor-networks-2
2. https://www.elprocus.com/introduction-to-wireless-sensor-networks-types-and-applications/
3. https://www.analog.com/en/design-center/landing-pages/002/apm/wsn-solution-2014.html

II B. Tech. – I Semester
(19BT31502) **OPERATING SYSTEMS**

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

PRE-REQUISITES:--

COURSE DESCRIPTION: Operating Systems Operations; Process Scheduling; Process Synchronization, Deadlocks; Paging and Segmentation, Disk Scheduling; File Concepts, I/O Interface; Concepts of Protection and Security.

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

CO1. Analyze performance of CPU scheduling algorithms.
CO2. Design solutions for process synchronization problems by using semaphores and monitors.
CO3. Devise solutions for deadlocks using deadlock handling mechanisms.
CO4. Solve memory management problems using page replacement and disk scheduling algorithms.
CO5. Identify efficient file allocation methods for optimal disk utilization.
CO6. Analyze services of I/O subsystems and mechanisms of security & protection.

DETAILED SYLLABUS:

UNIT I: INTRODUCTION TO OPERATING SYSTEM AND PROCESS MANAGEMENT (8 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 **(8 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 **(9 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 the lesson plan.

TEXT BOOKS:

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).

<u>Exercises on Packet Tracer Simulator Tool:</u>

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.

<u>Exercises on NS3 Simulator Tool:</u>

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.

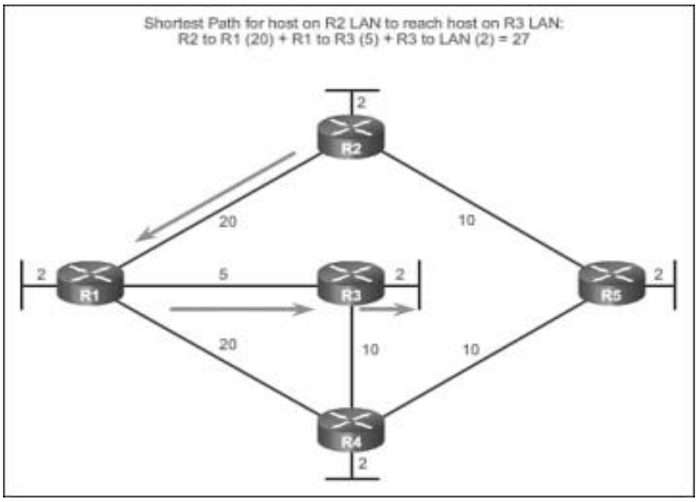
b) TCP model supports a full bidirectional TCP with connection setup and close logic. Simulate full duplex chat Transmission Control Protocol.

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:

1. Network simulator tools - NS3, Packet Tracer
2. Virtual Labs (Computer Networks Lab – http://vlabs.iitb.ac.in/vlabs-dev/labs_local/ computer-networks/ labs/explist.php)
3. Virtual Labs (Advanced Network Technologies Virtual Lab - http://vlabs.iitkgp.ernet.in/ant)

III B. Tech. – II Semester
(19BT61201) **CLOUD COMPUTING**

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

PRE-REQUISITES:--

COURSE DESCRIPTION: Fundamental Cloud Computing and Virtualization; Understanding Cloud Models and Architectures; Understanding Cloud Services, Applications and Capacity Planning; Exploring Platform as a Service (PaaS); Exploring Infrastructure as a Service (IaaS).

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

CO1. Demonstrate knowledge on basic concepts and terminologies of Cloud Computing and Virtualization.
CO2. Select appropriate Cloud deployment models, Service models and Architectures in Cloud Application development.
CO3. Analyze Cloud services, Applications and Capacity Planning.
CO4. Apply different PaaS application frameworks to construct Cloud applications.
CO5. Develop web applications through Google, Microsoft and Amazon web services as per societal needs.

DETAILED SYLLABUS:

UNIT I–FUNDAMENTAL CLOUD COMPUTING AND VIRTUALIZATION (10 Periods)

Cloud Computing: Origin and influences, Basic concepts and terminology, Goals and benefits, Risks and challenges, Roles and boundaries and Cloud characteristics.

Introduction to Virtualization: Characteristics, Taxonomy of virtualization technologies, Pros and cons of virtualization, Virtualization Technologies: Xen**,** VMware and Hyper-V.

UNIT II– UNDERSTANDING CLOUD MODELS AND ARCHITECTURES (8 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 (9 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).

Capacity Planning: 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) (8 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 this course, the students will be able to*:*

CO1.	Apply cryptographic protocols to ensure authentication in network systems.
CO2.	Analyze the efficiency of cryptographic techniques based on security attacks.
CO3.	Choose suitable key management scheme for efficient key exchange between the authenticated parties.
CO4.	Implement algorithms using information, complexity, and number theories for ensuring the security requirements-CIA.
CO5.	Evaluate Message Digest and Secure Hash Algorithms using hash functions for data Integrity.
CO6.	Analyze well known digital signature algorithms for securing communication.

DETAILED SYLLABUS:

UNIT I – FOUNDATIONS OF CRYPTOGRAPHY (8 Periods)

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 (8 Periods)

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)

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 (8 Periods)

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 **(9 Periods)**

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 (8 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 (7 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 (9 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:

1. Yuri Diogenes, ErdalOzkaya, *Cybersecurity: Attack and Defense Strategies*, 2nd Edition, Packt Publishing, 2019.
2. http://www.ignou.ac.in/upload/Announcement/programmedetails.pdf
3. 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 Cruptography.

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:

1. https://www.classcentral.com/course/udacity-applied-cryptography-326
2. https://www.classcentral.com/course/udacity-applied-cryptography-326
3. https://wiki.openssl.org/index.php/Command_Line_Utilities
4. 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 **(9 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 **(9 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 **(9 Periods)**
Identity lifecycle – authentication credentials– passwords, Symmetric keys, certificates, Biometrics, IoTIAM infrastructure Authorization and Access controls within publish/Subscribe protocols, access controls within communication protocols

UNIT IV – Mitigating IoT Privacy Concerns **(9 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 **(9 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

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 (8 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 (9 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 (8 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 (8 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 **(9 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 the 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)*", O. Reilly Media publisher, 2nd Edition, 2004.

REFERENCE BOOKS:

1. Behrousz A Forouzan, D Mukhopadhyay, "*Cryptography and network Security*", 1st Edition, McGraw Hill,2010.
2 Charlie Kaufman, Radia Perlman and Mike Speciner, *Network Security – Private Communication in a Public World,* 2nd Edition, 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. Marks	Ext. Marks	Total Marks	L	T	P	C
50	50	100	-	-	2	1

PRE-REQUISITES: A course on Information Security.

COURSE DESCRIPTION:
Windows Firewall Security Features, Introduction to wireshark tool, Pretty Good Privacy (PGP), Intrusion Detection System, SSL Certificate, and 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:

1. https://www.cengage.com/resource_uploads/downloads/1111138214_259146.pdf https://www.cmu.edu/iso/aware/presentation/tepperphd.pd
2. https://nvlpubs.nist.gov/nistpubs/SpecialPublications/NIST.SP.800-12r1.pdf
3. https://www.cs.unibo.it/babaoglu/courses/security/resources/documents/intro-to-crypto.pdf
4. 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 (8 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 (9 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 **(7 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 (8 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. Develop Programs for PIC18 using ports, timers and associated on Chip resources for Specified Applications.
CO4. Design microcomputer based systems with the knowledge of Interfaces and Peripherals of PIC18 to Solve various engineering problems.

DETAILED SYLLABUS:

UNIT-I: 80C51/31 (10 Periods)
Microprocessors vs Microcontrollers, 8051 Architecture, Internal and external memories, Addressing modes, Timers/Counters structure & configuration, Instruction set of 8051, simple programs using 8051.

UNIT-II: PIC ARCHITECTURE & PROGRAMMING (10 Periods)
Architecture of PIC18, Register Organization, Memory Organization - ROM space & RAM; Data formats & Directives, Instruction Set: Arithmetic, Logic, branching, Bit wise, bank switching, Simple PIC Programs.

UNIT-III: PORTS, TIMERS & PROGRAMMING (10 Periods)
Pin description of PIC18F452, Basic Port Structure, I/O port programming; Macros and modules, Structure of Timer 0 & its Programming using Assembly and C, Counter programming, Structure of timers 1, 2 and 3 & their Programming.

UNIT-IV: PIC - SERIAL PORT AND INTERRUPTS (7 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 (8 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 (9 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 (9 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 (9 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 **(8 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: A Course on VLSI Design.

COURSE DESCRIPTION: Need for Testing, Types of Testing, Fault Modeling, Test Methods for evaluation, Test Generation Algorithms, Delay Tests, IDDQ Tests, Ad-Hoc DFT Methods, Scan Based Designs, Built-In Self Test.

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

CO1. Understand the importance of Testing, fault models and related theorems.

CO2. Analyze various test methods, combinational and sequential circuit test generation Algorithms for Functional Verification of Digital Circuits.

CO3. Analyze delay test algorithms and IDDQ test algorithms for at-speed testing of CMOS Integrated Circuits.

CO4. Understand the concepts and architectures for Built-In Self Testto satisfy industry specifications.

DETAILED SYLLABUS:

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

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 **(Periods: 10)**

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 **(Periods: 11)**

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 **(Periods: 06)**

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 **(Periods: 09)**

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 system levels to develop CMOS devices.

DETAILED SYLLABUS:

UNIT-I: BASICS OF LOW POWER DESIGN (07 Periods)

Needs For Low Power VLSI Chips, Charging And Discharging Capacitances, Short Circuit Current in CMOS, CMOS Leakage Current, Static Current, Basic Principles Of Low Power Design, Low Power Figure Of Merits, Low Power VLSI Design Limits.

UNIT-II: POWER ANALYSIS AND ESTIMATION (10 Periods)

Spice Circuit Simulation, Discrete Transistor Modeling and Analysis, Gate Level Logic Simulation, Architecture Level Analysis, Data Correlation Analysis, Monte Carlo Simulation.

UNIT-III: LOW POWER CIRCUITS (11 Periods)

CIRCUIT ANALYSIS: Transistor and Gate Sizing, Equivalent Pin Ordering, Network Restructuring and Reorganization, Special latches and Flip flops.

LOGIC ANALYSIS: Gate Reorganization, Signal Gating, Logic Encoding, State Machine Encoding, Pre computation Logic.

UNIT-IV: SPECIAL TECHNIQUES (08 Periods)

Power Reduction in Clock Networks, CMOS Floating Node, Low Power Bus, Delay Balancing,Low Power Techniques for SRAM.

UNIT-V: ARCHITECTURE, SYSTEM & ADVANCED TECHNIQUES (09 Periods)

Power and Performance Management, Switching Activity Reduction, Adiabatic Computation, Pass Transistor Logic Synthesis, Asynchronous Circuit.

Total Periods: 45

Topics for Self Study are provided in the Lesson Plan

TEXT BOOK:

1. Gary Yeap, *Practical Low-Power Digital VLSI Design*, Springer Publication, 2012.

REFERENCE BOOKS:

1. A.P.Chandrakasan, R.W.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:

1. https://nptel.ac.in/courses/106/105/106105034/
2. 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: A course on Switching Theory and Logic Design/ Digital Logic Design.

COURSE DESCRIPTION: Design and verification of various combinational & sequential digital circuits through source code.

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

- CO1. Analyze simplification methods in logic circuits and perform desired logical operations optimally using logic gates.
- CO2. Design combinational circuits to perform arithmetic operations, data encoding and decoding, Multiplexing and Demultiplexing for engineering applications.
- CO3. Design sequential circuits for realizing counters and registers using flip-flops.
- CO4. Develop source code for Advanced Digital Design and perform functional verification.
- CO5. Work independently or in teams to solve problems with effective Communication.

LIST OF EXERCISES/LIST OF EXPERIMENTS:

Part-A: Basic Digital Design

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

Develop the source code for the following circuits and their test bench for verification. Also perform simulation, synthesis for given specifications

1. Buffer and basic gates.
2. Flip flops - RS, D, JK, T.
3. Adders and Subtractors.
4. 8-3 Encoder.
5. 3-8 Decoders.
6. 8x1 Multiplexer and 2x4 Demultiplexer.
7. Arithmetic and Logic Unit.
8. Synchronous &Asynchronous counter.
9. 4 Bit Comparator

Part-B: Advanced Digital Design (FPGA Implementation)

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

1. Write Verilog code for the design of 8-bit
   - i. Carry Ripple Adder
   - ii. Carry Look Ahead adder
   - iii. Carry Save Adder

2. Write Verilog Code for the design of 8-bit
    i. Array Multiplier (Signed and Unsigned)
    ii. Booth Multiplier (Radix-4)
3. Write Verilog code for the design of 4/8-bit
    i. Universal Shift Register
    ii. Parity Generator
4. Write Verilog code for the design of 4/8-bit
    i. Pseudo Random Pattern Generator
    ii. LFSR

5. Design a Mealy and Moore Sequence Detector using Verilog to detect Sequence.
   Eg. 11101 (with and without overlap) any sequence can be specified

Note: (For the experiments listed above, students can make the following flow of study
-RTL synthesis
-creation of power Analysis
-use of I/O 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: A Course on Microcontrollers/Microprocessors and Microcontrollers.

COURSE DESCRIPTION: MSP430 Architecture; Instruction Set; Programming; On-Chip Resources; Communication with peripherals; Embedded system design approaches.

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

CO1. Analyze MSP430 Architecture, Instruction Set, Addressing modes to develop programs for various control applications using Assembly and Embedded C.
CO2. Solve Problems by analyzing MSP430 On Chip Resources such as Timer, Clock System, Low Power Modes/techniques and Interrupt Structure.
CO3. Realize Mixed Signal Processing and Networking Applications, by analyzing on-Chip Resources such as Comparator, ADC, Temperature Sensor, PWM and Communication Peripherals.
CO4. Analyze Language, IDE Support, Processor IC & Design Technologies, and System Modeling Techniques to capture behavior of Embedded Prototype using suitable model.

DETAILED SYLLABUS:

UNIT-I: ARCHITECTURE OF MSP430 (09 Periods)
Embedded Systems – Introduction, MSP430 - Anatomy of microcontroller, Memory, Software, Pin out (MSP430G2553), Functional Block diagram, Memory, CPU, and Memory mapped input and output, Clock generator; Exceptions- Interrupts and Resets.

UNIT-II: PROGRAMMING MSP430 (09 Periods)
Development Environment, Aspects of C for Embedded Systems, Assembly Language, Register Organization, Addressing Modes, Constant Generator and Emulated Instructions, Instruction Set, Example programs- Light LEDs, Read input from a switch; Automatic Control-Flashing light by delay, use of subroutines and Functions; Basic Clock System, Interrupts and Low Power Modes.

UNIT-III: TIMERS AND MIXED SIGNAL SYSTEMS (09 Periods)
Timers - Watchdog Timer, RTC, Timer A, Measurement in capture mode, PWM generation; Mixed Signal Systems- Comparator A, ADC10 SAADC –Architecture, operation- Single Conversion, Temperature Sensor on ADC10, DTC in ADC10; ADC12 – Comparison with ADC10.

UNIT-IV: COMMUNICATION PERIPHERALS & PROTOCOLS (09 Periods)
MSP430 Communication Interfaces- USART,USCI, USI.
Communication Protocols- SPI, Inter-integrated Circuit Bus, USB, CAN.

UNIT-V: EMBEDDED SYSTEM DESIGN **(09 Periods)**

Processor Technology, IC Technology, Design Technology, Tradeoffs.

Model VS.Language, System Modelling – Data Flow Model, FSM, FSMD, HCFSM, PSM, Concurrent Process Model & implementation.

Total Periods: *45*

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. John H. Davies, *MSP430 Microcontroller Basics*, Newnes Publications, 1stEdition, 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 (9 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 (9 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 (9 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 (9 Periods)

Introduction, Failures- Causes, Types, Detection. Fault and Error Containment, Redundancy- Hardware, Software, Time, Integrated Failure Handling.

UNIT-V: OPERATING SYSTEMS (9 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 DESIGN AND VERIFICATION**

Int. Marks	Ext. Marks	Total Marks	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: A Course on Microcontrollers.

COURSE DESCRIPTION: Familiarization using IDE – CCS, Energia; Instruction Set usage; GPIO – programming; Watchdog timer; Timer, ADC, Comparator – Programming; Low Power Modes demonstration; PWM generation – Speed Control of DC Motor; Networking MSPs.

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

CO1. Analyze MSP430 Architecture, Instruction Set and Demonstrate Competence in developing programs using Assembly and Embedded C.
CO2. Solve various Problems using CCS and Energia IDE effectively by evaluating various on-chip resources.
CO3. Develop programs to realize control applications such as Speed control of DC Motor, Reading Ambient Temperature by investigating various interfacing techniques.
CO4. Survey usage of MSP430 for Mixed Signal Processing and IOT Applications to establish communication deploying various protocols.
CO5. Work independently and in teams to solve problems with effective Communication.

LIST OF EXERCISES/LIST OF EXPERIMENTS: *(Minimum Ten Experiments to be done)*

1. Introduction to MSP430 launch pad and Programming Environment.
2. Practice on usage of Instruction Set
3. Read input from switch and Automatic control/flash LED (software delay).
4. Interrupts programming example using GPIO.
5. Configure watchdog timer in watchdog & interval mode.
6. Configure timer block for signal generation (with given frequency).
7. Read Temperature of MSP430 with the help of ADC.
8. Test various Power Down modes in MSP430.
9. Generation of Pulse Width Modulation.
10. Use Comparator to compare the signal threshold level.
11. Speed Control of DC Motor
12. Master slave communication between MSPs using SPI.
13. Networking MSPs using Wi-Fi.

REFERENCE BOOKS/LABORATORY MANUALS:

1. John H Davies, *MSP430 Microcontrollers Basics*, Newnes Publishers, 1st Edition, 2008.
2. C P Ravikumar, *MSP430 Microcontrollers in Embedded System Projects*, Elite Publishing House , 1st Edition, 2012.

SOFTWARE/Tools used: Code Composer Studio Version 6, Energia, MSP430 launch pads, Wi-Fi booster pack.

MINOR DEGREE IN
POWER SYSTEMS AND DRIVES

Offering Department: ELECTRICAL AND ELECTRONICS ENGINEERING
Students of Eligible Branches: CSE, CSSE, IT, ECE, EIE, ME and CE

COURSE STRUCTURE

Year & Semester	Course Code	Course Title	Contact Periods per week				Credits (C)	Scheme of Examination Max. Marks		
			L	T	P	Total		Int. Marks	Ext. Marks	Total Marks
III B.Tech. I-Sem (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

.**Note:** If any student has chosen a course from the above list in their regular curriculum then, he/she is not eligible to opt the same course/s for the Minor degree. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course.

III B. Tech. – I Semester

(19BT50212) **ELECTRICAL ENGINEERING MATERIALS**

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

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

COURSE DESCRIPTION: Dielectric properties of organic and inorganic materials and their required properties; Dielectric properties of insulators in static fields and alternating fields; Breakdown of dielectric materials in presence of high voltages; polymer insulation materials and their behaviour in presence of High voltages; Applications of various dielectric materials in high voltage equipment.

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

- CO1. understand the dielectric properties of various organic and inorganic materials and their suitability for high voltage applications.
- CO2. realize the behavior of dielectric materials in the presence of static and in alternating fields.
- CO3. understand the breakdown mechanism of various dielectric materials in the presence of high voltages.
- CO4. realize the various polymer type insulation system for high voltage applications and the breakdown mechanism in composite insulation system.
- CO5. understand the suitability of various dielectric materials for various high voltage equipment.

DETAILED SYLLABUS:

UNIT-I: CONDUCTING AND SEMICONDUCTOR MATERIALS (07 Periods)
Ohms law and relaxation time of electrons, Electron scattering and resistivity of metals, thermal conductivity of metals, superconductivity; classification of semiconductors, Energy gap, conductivity in intrinsic semiconductors, Hall Effect and carrier density.

UNIT-II: DIELECTRIC PROPERTIES OF INSULATORS IN STATIC FIELDS AND ALTERNATING FIELDS (08 Periods)
Dielectric Properties of Insulating Materials, Various Types of Polarization in Dielectrics; Static dielectric constant, Polarization and dielectric constant, Internal fields in solids and liquids, static dielectric constant of solids, spontaneous polarization; Frequency dependency of polarization, Ionic polarization, complex dielectric constant, dipolar relaxation, dielectric losses.

UNIT-III: BREAKDOWN PHENOMENA OF DIELECTRIC MATERIALS (12 Periods)
BREAKDOWN IN GASES — Townsend's theory, Streamer's theory, breakdown in electro negative gases, Paschen's law, time lags of breakdown; insulation co-ordination.
BREAKDOWN IN SOLID DIELECTRICS — Thermal breakdown and electro mechanical breakdown, treeing and tracking, Internal discharges.

BREAKDOWN IN LIQUID DIELECTRICS — Suspended particle theory and stressed oil volume theory.

UNIT-IV POLYMER AND COMPOSITE INSULATING MATERIALS (09 Periods)

Polymeric Organic Materials, Thermoplastic Polymers, Thermoset Polymers, Polymer Compounds, Polyvinylchloride (PVC), Polyethylene (PE), Epoxy resins; Composite Insulating System—Impregnated Paper as a Composite Insulation System, Insulating Board Materials, Fiber Reinforced Plastics, Breakdown in composite insulators.

UNIT-V: APPLICATIONS OF INSULATION MATERIALS (09 Periods)

Applications in Power Transformers, Applications in Rotating Machines, Applications in Circuit Breakers, Applications in Cables, Applications in Power Capacitors, Applications in Electronic Equipment.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Dekker, Adrianus J. *Electrical engineering materials*. Prentice-Hall, 1959.
2. Naidu MS. *High voltage engineering*. Tata McGraw-Hill Education; 2013.

REFERENCE BOOKS:

1. Arora, Ravindra, and Wolfgang Mosch. *High voltage and electrical insulation engineering*. Vol. 69. John Wiley & Sons, 2011.

III B. Tech. – I Semester
(19BT50213) ELECTRICITY SAFETY AND SAFE PRACTICES

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

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

COURSE DESCRIPTION: The course deals with the various aspects of potential risk due to electrical shock; safety precautions to be followed while working in hazardous zones; safe practices while handling various electrical equipment and during maintenance; and relevant electrical safety standards and Indian rules and acts.

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

CO1. understand the Indian electricity rules, regulations and various standards to be maintained for safety of life and equipment.
CO2. understand the potential effects of electrical shock and safety measures to protect against such risk.
CO3. understand the safety aspects and safe practices to be followed while installing residential, commercial and agricultural appliances.
CO4. identify various hazardous working zones and take necessary precautionary measures while working in such areas.
CO5. follow safety measures during installation, testing, commissioning and maintenance of electrical equipment/plant.

DETAILED SYLLABUS:

UNIT-I: INDIAN ELECTRICITY RULES AND ACTS (09 Periods)
OSHA standards of electrical safety, Basic electrical safety rules as per OSHA; Objectives and scope of IE acts and IE rules; Significance of equipment earthing, Earthing of equipment bodies, structures and non-current carrying metallic parts, earthing of system neutral; Rules regarding first aid and firefighting facility, Electrical safety general requirements as per IE rules.

UNIT-II: ELECTRICAL SAFETY AND SAFETY MANAGEMENT (10 Periods)
ELECTRIC SAFETY: Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, Protection against electrical hazards and types, Effect of current on human body, Principles of electrical safety and approach to prevent accidents.

ELECTRIC SHOCKS AND ITS PREVENTION: Primary and secondary electrical shocks, possibilities of getting electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns.

UNIT-III: ELECTRICAL SAFETY IN RESIDENTIAL, COMMERCIAL AND AGRICULTURAL INSTALLATIONS (08 Periods)
Introduction—Wiring and fitting; Domestic appliances—water tap giving shock, shock from wet wall, fan firing shock; Multi-storied building, Temporary installations, Agricultural

pump installation; Do's and Don'ts for safety in the use of domestic electrical appliances; Principles of safety management in electrical plants.

UNIT-IV: ELECTRICAL SAFETY IN HAZARDOUS AREAS (08 Periods)

Hazardous zones—class 0, 1 and 2; Sparks, flashovers and corona discharge in electrical plants; equipment for hazardous locations; Equipment/Enclosures for hazardous gases and vapours; Classification of Enclosures for hazardous locations; Explosives and provisions of Explosives Act.

UNIT-V: SAFETY DURING INSTALLATION, TESTING AND 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 BOOKS:

1. S.Rao, Prof. H.L.Saluja, *Electrical Safety, Fire Safety Engineering and Safety Management*, 2nd Edition, Khanna Publishers. New Delhi, 2018 Reprint.

REFERENCE BOOKS:

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 of wind energy conversion technologies.

CO4. understand the generating principles and operational aspects of Ocean 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, Battery.

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: A course on Basic Electrical and Electronic Engineering

COURSE DESCRIPTION: Exercises on assessing of electrical parameters and functionality of electrical apparatus; Design and estimation of electrical systems, and protection system for electrical devices and systems; Troubleshooting of electrical appliances and calibration of measuring instruments.

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

- CO1 demonstrate the usage of power tools for installation applications and cable laying with relevant accessories.
- CO2 install panel boards for domestic/industrial applications, design and estimate wiring requirements following the code of conduct.
- CO3 practice the measurement of electrical quantities using modern day tools and also calibrate the precession of the measuring instruments.
- CO4 Realize the protection equipment used in domestic/industry and practice protection schemes for a particular application.
- CO5 demonstrate the practice of using various ancillary equipment for electrical appliances and also troubleshoot in the case of malfunctioning of electrical appliances.
- CO6 work independently or in teams to solve problems with effective communication.

List of Exercises/List of Experiments:
*(Minimum **Ten** experiments are to be conducted)*

1. Identification and usage of hand and power tools, PPE for electrical installation applications.
2. Practice of cable laying and termination using conduits, casings, cable joints and its necessary items.
3. Installation and testing of single/three phase distribution boards for domestic/industrial applications.
4. Design and estimation of wiring for a typical house.
5. Measurement of electrical quantities using analog and digital meters.
6. Practice energy meter for measurement of energy and tariff estimation.
7. Calibration of measuring instruments.
8. Operation and testing of Fuse, MCB and Relays.
9. Measurement of equipment to earth resistance and determine the internal leakage currents.
10. Practicing and testing of DOL starter for Induction Motors.
11. Design of Timers for operation of electrical appliances.
12. Troubleshooting of electrical appliances — Fan, Mixer/grinder, Water heater/Iron box.

REFERENCE BOOKS/LABORATORY MANUALS:

1. http://www.srisaiuniversity.org/downloads/files/n59b79d6117211.pdf
2. https://www.gtu.ac.in/syllabus/NEW_Diploma/sem-1/Pdf%20Content%20detailing/3312401Electrical%20&%20Electronic%20Workshop.pdf

ADDITIONAL LEARNING RESOURCES:

1. https://www.youtube.com/watch?v=ax-KUL17YJ4
2. https://www.youtube.com/watch?v=TJpQ3fZIt20
3. https://www.youtube.com/watch?v=6RJnsa83xTA
4. https://www.youtube.com/watch?v=w2M4tS2OMsU
5. https://www.youtube.com/watch?v=DzVJiSQNbew

III B. Tech. – II Semester

(19BT60213) **PRINCIPLES OF ENERGY AUDITING AND CONSERVATION**

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

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

COURSE DESCRIPTION: Principles of energy audit, management and conservation; Energy efficient motors, lighting schemes; Energy measuring instruments and significance of energy economics.

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

CO1. apply the relevant rules, regulations and procedure of energy audit in industries and realize the energy management principles and protocols for effective conservation of energy.

CO2. analyze performance of energy efficient motors and illumination system by applying the relevant protocols of energy auditing.

CO3. apply appropriate energy auditing instruments for energy auditing in industries and assess their economic benefits.

CO4. apply the demand side management techniques and relevant standards for organization of energy conservation awareness programs.

DETAILED SYLLABUS:

UNIT-I: ENERGY AUDIT AND MANAGEMENT PRINCIPLES (10 Periods)

Energy audit — definitions, concept, types of audit, energy index-cost index, pie charts, Sankey diagrams, load profiles,energy saving potential, energy audit of process industry, building energy audit; IE rules and regulations for energy audit.

Energy management — Principles of energy management, organizing energy management program, initiating, planning, controlling, promoting, monitoring, reporting.

UNIT-II: ENERGY CONSERVATION PRINCIPLES (08 Periods)

Energy scenario in India and world; Rules for efficient energy conservation; Technologies for energy conservation; Principles of energy conservation, roles and responsibilities of energy managers and auditors in industries.

UNIT-III: ENERGY EFFICIENT MOTORS AND LIGHTING (09 Periods)

Energy efficient motors - factors affecting efficiency, loss distribution, constructional details, characteristics, variable speed, variable duty cycle systems.

Lighting -Good lighting system, lighting control, lighting energy audit.

UNIT-IV: ENERGY INSTRUMENTS AND ECONOMIC ANALYSIS (10 Periods)

Principles of energy instruments— Infrared thermometer, data loggers, thermo-couples, pyrometers, Lux meters, tongue testers, power quality analyzer, and PLC and pic applications (Block diagram approach).

Principles of Energy Economic Analysis— The time value of money concept. Cash flow models, payback analysis, depreciation.

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

PRE-REQUISITES: --

COURSE DESCRIPTION: Construction, Working, Types, control operation, characteristics and applications of Stepper Motors, Switched Reluctance Motors, Synchronous Reluctance Motors, Permanent Magnet Brushless DC Motors and Linear Induction Motors.

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

CO1. analyze the open and closed loop operational characteristics of stepper motor and assess its performance under various scenarios.

CO2. analyse the operational aspects of switched reluctance motor to assess the performance and design the constructional features for sustainability.

CO3. analyse the operational aspects of synchronous reluctance motor to assess its performance, sustainability and applications.

CO4. analyse the sensorless and sensor based operation and control aspects of permanent magnet brushless DC motor and assess the performance under diverse scenarios.

CO5. analyze the operational and control aspects of linear induction motor and assess their performance for special applications.

DETAILED SYLLABUS:

UNIT-I: STEPPER MOTORS (9 Periods)

Constructional features, types, working principle, torque equation, characteristics, open loop and closed loop control of stepper motor, applications.

UNIT-II: SWITCHED RELUCTANCE MOTORS (9 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 (9 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 (9 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 (9 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, the students 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 (8 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 (7 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, 2005 reprint.
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, 2nd Edition, 2006. E.Openshaw Taylor, Utilization of Electric Energy, Orient Longman, 1971.

ADDITIONAL LEARNING RESOURCES:

1. https://www.NPTEL video lectures.
2. https://www.opto-e.com/basics/led-pulsing-and-strobing

III B. Tech. – II Semester
(19BT60234) **AUDITING AND CONSERVATION PRACTICE LAB**

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

PRE-REQUISITES:--

COURSE DESCRIPTION: Experimental investigations on behavior of insulators, performance of synchronous and asynchronous machines, relay testing and fault analysis.

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

CO1. demonstrate skill in identifying an appropriate auditing tool for measuring appropriate electrical and non-electrical preliminary quantities for auditing.
CO2. demonstrate skills to apply the auditing principles for illumination, house hold utilities and suggest a suitable conservation methods for economic benefits.
CO3. demonstrate skills to audit various industrial drives and suggest suitable methods for energy conservation adhering the protocols of auditing.
CO4. perform auditing by following the auditing protocols in various commercial, agricultural and domestic class of customers and suggest an appropriate energy conservation practices for economical benefits.
CO5. work independently or in teams to solve problems with effective communication.

Practical Exercises/List of Experiments:
(Minimum Ten experiments are to be conducted.)

1. Demonstration of auditing instruments for measuring electrical and non-electrical quantities for auditing purpose.
2. Measurement of active, reactive power and energy for auditing purpose.
3. Assess power quality problems using power quality analyzer and suggest a suitable conservative measures to mitigate.
4. Testing of Electric motor drive for energy conservation.
5. Analyze star labeled electrical apparatus and compare the data sheet of various star ratings.
6. Determine energy consumption by fluorescent/incandescent lamp and evaluate net energy savings and payback period by replacing with energy efficient lamp.
7. Evaluate energy conservation in a ceiling fan with and without an electronic regulator.
8. Conserve the energy consumption in a three phase induction motor by applying an appropriate energy conservation method.
9. Determine the energy conservation in an induction motor operating in star and delta mode of operation.
10. Estimate energy and economic savings by improving power factor for a given class of consumer.
11. Estimate the economic benefits of improving load factor for a domestic consumer.
12. Audit the energy of a commercial consumer and suggest an appropriate energy conservation practice to reduce energy bill.

ADDITIONAL LEARNING RESOURCES:

1. https://sites.google.com/a/venusict.org/energy-conservation-and-management/ntpl-video-links
2. https://nptel.ac.in/courses/108/105/108105058/
3. https://www.youtube.com/watch?v=Nd_EL_B3JBQ
4. https://www.youtube.com/watch?v=lkNIuFkzxBk
5. https://www.youtube.com/watch?v=730netBSZKY
6. https://www.youtube.com/watch?v=R_FdTPbgzTs

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*, New York, 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. Mehrdad Ehsani, Yimin Gao and Ali Emadi, *Modern Electric, Hybrid Electric and Fuel Cell Vehicles*, 2nd Edition, CRC Press, 2015.
4. Chris Mi, M. Abul Masrur, David Wenzhong Gao, *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: A course on Basic Electrical and Electronics Engineering.

COURSE DESCRIPTION: Overview of protective schemes; fuses; circuit breakers; electromagnetic relays; protective schemes applied for various components under various operating conditions; different grounding schemes.

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

CO1. apply the conceptual knowledge of various fuses for secured operation of domestic and industrial appliances.

CO2. apply the conceptual knowledge of various circuit breakers for secured operation of power system network.

CO3. apply the conceptual knowledge of various relays for secured operation of power system network.

CO4. analyze various protection schemes for the protection of alternators, transformers and motors.

CO5. apply various neutral grounding methods and determine the system parameters for protection in power system.

DETAILED SYLLABUS:

UNIT-I: FUSES **(6 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 **(9 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 **(8 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,* 24th Edition, 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, EEE, ECE, 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-REQUISITS:--

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 (9 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 **(8 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 **(8 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 **(9 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, 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

IIIB. Tech. – I Semester

(19BT41001) INDUSTRIAL INSTRUMENTATION

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

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 (8 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 (7 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 (9 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

IIIB. Tech. – I Semester

(19BT71004) COMPUTER CONTROL OF PROCESS

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

COURSE DESCRIPTION: Analysis of discrete state variable system identification techniques, direct discrete design techniques, advanced control strategies used in industries, Adaptive Control.

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

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

CO2. Design of controllers based on discrete time models are used in Industries.

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

CO4. 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 (8 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 (9 Periods)

Computer control loop, Converting continuous time controller to discrete time domain, Design of controllers based on discrete time model beat and Dahlin’s algorithms. Design of Feed Forward Controller: Block Diagram.

UNIT-IV: ADVANCED PROCESS CONTROL STRATEGIES (9 Periods)

Cascade Control- Dynamic response, Types, Implementation, Predictive Control–Model based and Multivariable System, Statistical Process Control. Algorithms for Processes with Dead Time–Smith Predictor, Analytical Predictor.

UNIT-V: ADAPTIVE CONTROL **(8 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/

IIIB. Tech. – I Semester

(19BT41031) INDUSTRIAL INSTRUMENTATION LAB

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

PRE-REQUISITS: A course on Industrial Instrumentation.

COURSE DESCRIPTION: LabVIEW basics; Circuit design and simulation in Multisim; Measurement of Torque, Temperature, Viscosity, Humidity, Pressure, Level and Flow.

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

CO1. Apply the LabVIEW functions in programming.

CO2. Simulate electrical circuits using Multisim.

CO3. Analyze the characteristics of measuring instruments by applying the fundamental concepts.

CO4. Develop PC based data logger systems by interfacing hardware devices like myRIO, ELVIS and required sensors for measurement.

CO5. Design and solve problems in the measurement of parameters for required specifications.

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

LIST OF EXPERIMENTS:

(Minimum ELEVEN experiments are to be conducted)

1. LabVIEW Basics : Practice of Virtual Instrumentation Course content

Numeric, Boolean, Strings, For, While, Case Structures, Arrays, Clusters, Sequence: Flat, Stacked, Formula Node, SubVI's, Local/Global Variables.

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

a) I to V

b) V to I

5. Design and verification of resistance measurement, conversion in 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 PallásAreny, John G. Webster, *Sensors and Signal Conditioning*, John Wiley and Sons, 2nd Edition, 2000.
6. A. K. Sawhney, *A Course in Electrical and Electronics Measurements and Instrumentation*, Dhanpat Rai and Sons, 19th Edition, 2011.

SOFTWARE/Tools used:

1. NI Labview 2018
2. NI Circuit Design Suite – Multisim 2019
3. NI myRIO
4. NI ELVIS

ADDITIONAL LEARNING RESOURCES:

1. https://www.ni.com/pdf/manuals/320999e.pdf
2. https://ieeexplore.ieee.org/document/8960023/
   A Different way of Level measurement for PBL in Education of Students using NI-LabVIEW, Multisim and MyRIO
3. http://www.ni.com/pdf/manuals/376047c.pdf
4. https://www.clemson.edu/cecas/departments/ece/document_resource/undergrad/lab_manuals/NI_ELIVS_II_Orientation_Manual.pdf
5. http://www.ni.com/pdf/manuals/374629c.pdf
6. http://www.ni.com/pdf/manuals/373363f.pdf

IIIB. Tech. – II Semester

(19BT71003) **AIRCRAFT INSTRUMENTATION**

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

PRE-REQUISITS:--

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 (8 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 (7 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-REQUISITS:--

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 (8 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 (9 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 (8 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

(19BT61005) **SMART SENSORS**

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

PRE-REQUISITS:--

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 (8 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 (9 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 **(9 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 **(9 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. 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. **Smartsensors:**
   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-REQUISITS: 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, 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

IV B. Tech. – I Semester

(19BT71001) BIOMEDICAL INSTRUMENTATION

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

PRE-REQUISITS: --

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 (9 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 (9 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 (9 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 (9 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 (9 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

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

IV B. Tech. – I Semester

(19BT71002) PROGRAMMABLE LOGIC CONTROLLERS

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

PRE-REQUISITS: --

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 (9 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 (9 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 (9 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 (8 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*, 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-REQUISITS: 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.

CO4. 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 the respective course.

III B. Tech. – I Semester
(19BT50316) COMPUTER INTEGRATED MANUFACTURING

Int. Marks	Ext. Marks	Total Marks	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 (9 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 (9 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 (9 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 **(9 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: **(9 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 (9 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 (9 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 (9 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 (9 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 (9 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 controls for a configurations.

DETAILED SYLLABUS:

UNIT- I: STATICS **(9 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 **(9 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 **(9 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 **(9 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 **(9 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.

REFERENCES:

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 (9 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 (9 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 (9 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 (9 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 (9 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, 4th Edition, 2011.

REFERENCE BOOKS:

1. M.P. Groover, Automation, *Production systems and Computer Integrated Manufacturing*, Fourth Edition, PHI Learning, 2016.
2. Geoffrey Boothroyd, *Assembly Automation and Product design*, Taylor and Francis Publishers, Second Edition 2005.

III B.Tech. II-Semester

(19BT60322) PRINCIPLES OF ROBOTICS

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

PRE-REQUISITES: -

COURSE DESCRIPTION: Brief history - Robot – Definition, Various robot manipulators – Linear and angular velocities, tactile, proximity and range sensors, End Effectors and robot economics

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

CO1. Demonstrate knowledge of robotics, its specifications, functions and different applications.
CO2. Demonstrate knowledge on various robot manipulators
CO3. Demonstrate knowledge on sensors, work cells and programming languages.
CO4. Analyze functional characteristics of robot end effectors through design considerations.
CO5 Analyze economic aspects of robots by considering different safety parameters.

DETAILED SYLLABUS:

UNIT-I: BASIC CONCEPTS (9 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 (9 Periods)

Various robot manipulators, Linear and angular velocities, Manipulator Jacobian, Prismatic and rotary joints, Robotic Inverse, Wrist and arm singularity.

UNIT-III: ROBOT SENSORS (9 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 (9 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 (9 p*eriods*)

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 (9 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 (9 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 (9 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: (9 Periods)

Langrangian mechanics; Two degree of freedom manipulator–Dynamic model, Lagrange –Euler formulation, Newton–Euler formulation; Comparison of Lagrange–Euler formulation and Newton–Euler formulation; Inverse dynamics.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Robert J. Schilling, *Fundamentals of Robotics Analysis and Control,* PHI Learning, 2011.
2. R.K.Mittal and Nagrath*, Robotics and Control, TMH, 2017.*

REFERENCE BOOKS:

1. Niku S B*, Introduction to Robotics, Analysis, Systems, Applications,* Prentice Hall, Second Edition 2006.
2. Geoffrey Boothroyd, *Assembly Automation and Product design*, Taylor and Francis Publishers, Second Edition 2005.

IV B.Tech I Semester

(19BT70315) APPLIED AND INDUSTRIAL ROBOTICS

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

PRE-REQUISITES: -

COURSE DESCRIPTION: General considerations in Robot material handling, material transfer application, machine loading and unloading, CNC machine tool loading; repeatability, maximum working envelop, kinematic and state values. Robot safety Considerations, Factors affecting robot safety measures; Cooperative manipulation; field robots and robots in health care

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

CO1. Demonstrate the knowledge on robotic material handling and assembly systems.

CO2. Demonstrate the knowledge of expert systems in robotic performance testing and safety

CO3. Demonstrate the knowledge on various cooperative and SWARM robots and its applications.

CO4. Analyze robotic configurations and specifications for field and service applications.

CO5. Demonstrate the core concepts of robots in medical applications.

DETAILED SYLLABUS:

UNIT- I: ROBOT MATERIAL HANDLING (10 periods)
General considerations in Robot material handling, material transfer application, machine loading and unloading, CNC machine tool loading, Robot centered cell Assembly and parts presentation methods, Assembly operation, Compliance and the Remote center compliance (RCC) Device, Assembly system configurations, Adaptable programmable assembly system, Designing for robotic assembly, Inspection automations - vision inspection system, robot - manipulated inspection.

UNIT- II: EXPERT SYSTEMS (9 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 (7 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 **(9 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, 4th 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, -*Mobile Robots Towards New Applications*, Advanced Robotic Systems International, 2006.
3. L Marques,A de Almeida,Mo Tokhi,GSVirk, -*Advances in Mobile Robotics*, World Scientific Publishing Co. Pte. Ltd. 2008.
4. Bruno Siciliano, OussamaKhatib, -*Springer Handbook of Robotics*, Springer-Verlag Berlin Heidelberg, 2008.

IV B.Tech. – I Semester

(19BT70316) ROBOTIC PROGRAMMING

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

PRE-REQUISITES: --

COURSE DESCRIPTION: Robotic programming; Robotic software functions; Program planning; Modes of programming; Commands for motion control; Lead through robotic programming; Textual robotic programming; End effectors and sensors commands; Program control and subroutines; VAL II Programming; AML Programming;

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

- CO1. Demonstrate the knowledge of basic planning schemes involved in development of robotic programming.
- CO2. Develop Programmes for robots based on the techniques of 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 (9 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 (9 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 (9 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 (9 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 (9 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, 2nd Edition, 1993.
3. S.R. Deb and S.Deb *Robotic Technology and Flexible Automation,* Second Edition McGraw Hill Education India., 2012

REFERENCES:

1. JJ Craig, *Introduction to Robotic Mechanics and Control*, Pearson, 3rd 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 (9 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 (9 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: (9 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 (9 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 **(9 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 the respective course.

III B.Tech. - I Semester
(19BT40107) **SUSTAINABLE ENGINEERING**

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

PRE-REQUISITES: -

COURSE DESCRIPTION: Principles of sustainability; Sustainability metrics and assessment tools; Sustainable engineering practices; Sustainable engineering applications; Sustainable urbanization and industrialization.

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

CO1. Analyze the principles of sustainability to solve complex environmental problems following relevant standards/protocols considering society, health, safety and environment.

CO2. Analyze sustainability metrics and assessment tools to solve complex environmental problems following relevant standards and emerging trends considering society, health, safety, environment and economics besides communicating effectively in graphical form.

CO3. Analyze sustainable engineering practices to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO4. Design sustainable engineering applications to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

CO5. Analyze sustainable urbanization and industrialization principles to solve complex environmental problems using appropriate tools and techniques following relevant standards considering society, health, safety, environment, economics and management besides communicating effectively in graphical form.

DETAILED SYLLABUS:

UNIT - I: PRINCIPLES OF SUSTAINABILITY (09 Periods)

Emerging challenges, Sustainability and sustainable engineering; Environmental concerns; Social, economic and legal issues; Availability and depletion of natural resources, Disaster resiliency; Multilateral environmental agreements – Basel convention, Clean development mechanism (CDM), Montreal and Kyoto protocols.

UNIT – II: SUSTAINABILITY METRICS AND ASSESSMENT TOOLS (09 Periods)

Sustainability indicators, metrics and assessment tools, Material flow analysis and material budget, Carbon footprint analysis, Life cycle assessment, Streamlined life-cycle assessment (SLCA), Economic input output-life cycle analysis, Environmental health risk assessment, Other emerging assessment tools.

UNIT - III: SUSTAINABLE ENGINEERING PRACTICES (09 Periods)

Sustainable energy engineering, Sustainable waste management, Green and sustainable buildings and infrastructure, Sustainable civil infrastructure, Sustainable remediation of contaminated sites, Climate geoengineering.

UNIT - IV: SUSTAINABLE ENGINEERING APPLICATIONS (09 Periods)

Environmental and chemical engineering projects, Materials engineering projects, Infrastructure engineering projects – Background, Methodology, Goal and Scope, Study area, Technical design, Environmental sustainability, Life cycle assessment, Economic sustainability, Social sustainability, Rating systems – ENVISION, LEED, GRIHA, IGBC; Conclusions.

UNIT – V: SUSTAINABLE URBANIZATION AND INDUSTRIALIZATION

(09 Periods)

Sustainable urbanization and industrialization, United Nations sustainable development goals – Right to education, Poverty eradication, Social and technological changes; Industrial Processes - Material selection, Energy efficiency, Pollution prevention and control techniques, Industrial Ecology, Industrial symbiosis.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Reddy, K. R., Cameselle, C., and Adams, J. A., *Sustainable Engineering: Drivers, Metrics, Tools, and Applications*, John Wiley & Sons, Inc., Hoboken, New Jersey, 2019,
2. Allen, D. T. and Shonnard, D. R., *Sustainability Engineering: Concepts, Design and Case Studies*, Pearson Education, 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

PRE-REQUISITES: Course on Environmental Science

COURSE DESCRIPTION: Ecology; Ecosystem; Ecological impact assessment, Ecotoxicology and bio-monitoring, Restoration ecology.

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

CO1. Demonstrate the basic knowledge on ecology to provide solutions to environmental problems using appropriate tools and techniques considering society, health, environment and sustainability besides communicating effectively in graphical form.

CO2. Analyze the ecosystems to solve environmental problems using appropriate tools and techniques considering society, health, safety, environment and sustainability besides communicating effectively in graphical form.

CO3. Analyze the ecological impact assessment to solve complex environmental problems using appropriate tools and techniques following relevant standards and norms considering society, health, safety, environment, sustainability and economics besides communicating effectively in graphical form.

CO4. Analyze the eco-toxicology effects and bio-monitoring of ecosystems to solve complex environmental problems using appropriate tools and techniques following relevant standards and norms considering society, health, safety, environment, sustainability and project management besides communicating effectively in graphical form.

CO5. Analyze ecology of disturbed ecosystems, reconstructions and restoration of natural ecosystems to solve complex environmental problems following relevant standards and latest developments considering society, health, safety, environment, sustainability and project management besides communicating effectively in graphical form.

DETAILED SYLLABUS:

UNIT - I: ECOLOGY (10 Periods)

Scope, concept and multidisciplinary nature of ecology; Organizational level of ecological systems, Abiotic and biotic environment, Limiting factors, Adaptation, Habitat and niche, Holocoenotic nature of environment, Concept of biosphere; Landscape, population and community ecology; Synecological principles, Species area relations, Methods of sampling and describing plant community, Ecological succession, Succession models, Concept of climax.

UNIT - II: ECOSYSTEM (8 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 be able to:

CO1 Analyze waste to energy process to solve waste management challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO2 Analyze municipal solid waste characteristics and sampling techniques to solve solid waste management challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO3 Analyze thermochemical waste to energy technologies to solve solid waste management challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO4 Analyze traditional and advanced biological technologies for converting waste to energy using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO5 Analyze energy plants and the environment to solve waste to energy challenges using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

DETAILED SYLLABUS:

UNIT - I: WASTE TO ENERGY CONCEPT (09 Periods)
Waste to energy- A historical 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	L	T	P	C
40	60	100	3	-	–	3

PRE-REQUISITES: Course 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 provided 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

PRE-REQUISITES: 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 on Environmental 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	L	T	P	C
40	60	100	3	-	–	3

PRE-REQUISITES: Courses on Environmental Science, Sustainable Engineering.

COURSE DESCRIPTION: Fundamentals of environmental economics; Economy and the natural environment interaction; Economic development and environment; Valuation of environmental goods and services; Sustainable economic development.

COURSE OUTCOMES: After successful completion of this course, the students will be 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 provided 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 on Environmental Science, Sustainable Engineering.

COURSE DESCRIPTION: Sustainability and urban development; Functions of cities; Inclusive, Safe and productive cities; Sustainable urban services and infrastructure; Governing sustainable cities.

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

CO1 Analyze sustainability and urban development to solve problems associated with cities using appropriate tools and techniques following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO2 Analyze city functioning for sustainability to solve problems associated with cities using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO3 Analyze inclusiveness, safety and productivity in cities to solve problems associated with cities using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO4 Analyze sustainable urban services and infrastructure to solve problems associated with cities using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment, sustainability and economics besides communicating effectively in graphical form.

CO5 Analyze governance for sustainable cities to solve problems associated with cities using different tools and techniques considering latest developments, relevant guidelines, environment and sustainability besides communicating effectively in graphical form.

DETAILED SYLLABUS:

UNIT - I: SUSTAINABILITY AND URBAN DEVELOPMENT (08 Periods)

The urban opportunity; Cities - Cultural and social transformation; Challenge of urban politics, Planning and governance, Urban research methods, Urban theory and history, Urban development and the environment, Urban growth and the environment - Why cities grow?, Externalities and the environment, Urban economic restructuring, City size and settlement planning.

UNIT - II: FUNCTIONS OF CITIES (09 Periods)

Understanding urban systems, Municipal, Regional and national governance, Urban utilities, Urban public finance and taxation; Law, order and conflict; Land management and planning, Lessons from London and Mumbai.

UNIT - III: INCLUSIVE, SAFE AND PRODUCTIVE CITIES (10 Periods)

What is urban poverty?, Measuring urban poverty, Poverty reduction in cities, Affordable and adequate housing, Who can deliver the housing we need?, Safety and violence, Urban vulnerabilities; Making cities productive and reduce inequality- City production and consumption, Women in the informal economy, Migration, mobility and the urban-rural continuum Wealth and inequality, Case: SEWA, India, Migration and the refugee crisis; Improving human development in cities – Addressing the challenges of urban public health, Solutions for improving urban health, Education and skills, Higher education in cities, Gender in the city, Human rights and justice, Law and equality, Apartheid in South African cities.

UNIT - IV: SUSTAINABLE URBAN SERVICES AND INFRASTRUCTURE (08 Periods)

Sustainable environmental services and infrastructure, Sustainable transport planning, ICT, Sustainable urban energy systems, Sustainable transport: Bangkok; How can cities be resilient - Air, water, food and natural resources; City risk exposure; Climate impacts, adaptation and mitigation; Building urban resilience, Environmental planning and the politics of change.

UNIT - V: GOVERNING SUSTAINABLE CITIES (10 periods)

Sustainable environmental practices, Urban disaster risk management, Post-disaster recovery, SDGs and other global processes, New institutions and governance, Public participation and democracy, Financing sustainable development, Measuring and monitoring the SDGs, Opportunities of secondary cities.

Total Periods: 45

Topics for self-study are provided 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 on Environmental Science, Sustainable Engineering.

COURSE DESCRIPTION: Sustainability and sustainable development; Product life cycle design – Methods and strategies; Product life cycle design – Software tools; Designing for sustainable product-service system – Methods and tools; Design for sustainability – Engineering design criteria and guidelines.

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

CO1 Analyze sustainability and sustainable development to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

CO2 Analyze product life cycle design methods and strategies to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

CO3 Analyze product life cycle design software tools to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

CO4 Design sustainable product-service systems to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

CO5 Design engineering criteria and guidelines to solve complex problems associated with sustainable design of technology systems using appropriate tools and techniques, following relevant codes, regulations and latest developments considering society, environment and economics besides communicating effectively in graphical form.

DETAILED SYLLABUS:

UNIT - I: SUSTAINABILITY AND SUSTAINABLE DEVELOPMENT (09 Periods)

Sustainability and sustainable development - Understanding un-sustainability and need for Sustainability, Definitions, Pathway, Systems approach to design; Evolution of sustainability within design - Diverse approaches to design for sustainability, Relationship between approaches to design for sustainability and the application context.

UNIT - II: PRODUCT LIFE CYCLE DESIGN – METHODS AND STRATEGIES (08 Periods)

Life Cycle Assessment (LCA) - Product Life Cycle Assessment, LCA introduction, LCA methodology, LCA goal, LCA scope, Inventory analysis, Impact assessment, Interpretation; Environmental risk, Environmental impacts calculation by using LCA technique, Risk assessment with concepts of LCA.

UNIT - III: PRODUCT LIFE CYCLE DESIGN – SOFTWARE TOOLS (08 Periods)

History of product design by LCA with examples; ISO 14000, Life cycle analysis, SIMA PRO, LCA software and other software for LCA, LCA methodical challenges - Allocation and uncertainty, Sensitivity analysis.

UNIT - IV: DESIGNING FOR SUSTAINABLE PRODUCT-SERVICE SYSTEM – METHODS AND TOOLS (10 Periods)

Sustainable product service system design – Definition, Types and examples; Sustainable product service system – Transition path and challenges, Sufficiency economy philosophy applied to sustainable product-service system (PSS) thinking, Khadi movement as a precursor to PSS thinking.

UNIT - V: DESIGN FOR SUSTAINABILITY – ENGINEERING DESIGN CRITERIA AND GUIDELINES (09 periods)

Sustainable product-service system design applied to distributed economy, Other design for sustainability tools and approaches – Agriculture, Cities and communities, Carbon footprint, Green buildings, Green materials, Green energy, Sustainable development, Zero waste, Circular economy.

Total Periods: 45

Topics for self-study are provided in the lesson plan.

TEXT BOOKS:

1. Horne, Ralph, Tim Grant, and Karli Verghese, *Life Cycle Assessment: Principles, Practice and Prospects*, Csiro Publishing, 2009.
2. Bhamra, Tracy, and Vicky Lofthouse, *Design For Sustainability: A Practical Approach*. Routledge, 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.
2. Curran, Mary Ann, *Life Cycle Assessment Student Handbook*, John Wiley & Sons, 1st Edition, 2015.
3. Hauschild, Michael Z., Ralph K. Rosenbaum and Stig Irvin Olsen, *Life Cycle Assessment*, Springer International Publishing, 2018.
4. Hendrickson, Chris T., Lester B. Lave, and H. Scott Matthews, *Environmental Life Cycle Assessment of Goods and Services: An Input-Output Approach*. Routledge, 2010.

ADDITIONAL LEARNING RESOURCES:

1. Sharmistha Banerjee, System Design for Sustainability, IIT Guwahati, https://nptel.ac.in/ courses/107/103/107103081/.
2. Curran, Mary Ann, *Life Cycle Assessment Handbook: A Guide for Environmentally Sustainable Products*, John Wiley & Sons, 3rd Edition, 2012.