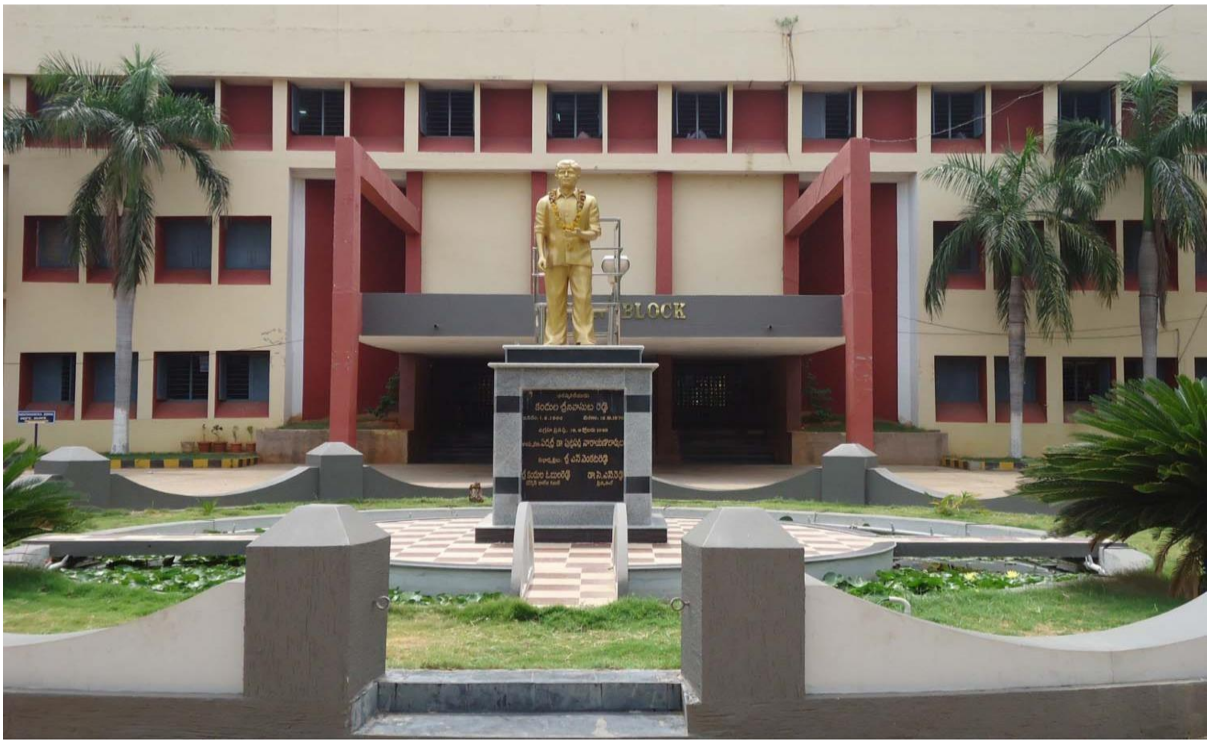
Regulations, Curriculum and Syllabus for

UG Programs in Engineering (R20UG)

(Effective from 2020-21 for Regular students and from 2021-22 for Lateral Entry students)

ELECTRICAL AND ELECTRONICS ENGINEERING



Kandula Srinivasa Reddy Memorial College of Engineering
(Autonomous)
Kadapa 516005, AP
(Approved by AICTE, Affiliated to JNTUA, Ananthapuramu, Accredited by NAAC) (An ISO 9001-2008 Certified Institution)

VISION AND MISSION OF THE INSTITUTE

VISION

To evolve as center of repute for providing quality academic programs amalgamated with creative learning and research excellence to produce graduates with leadership qualities, ethical and human values to serve the nation.

MISSION

M1: To provide high quality education with enriched curriculum blended with impactful teaching-learning practices.

M2: To promote research, entrepreneurship and innovation through industry collaborations.

M3: To produce highly competent professional leaders for contributing to Socio-economic development of region and the nation.

VISION AND MISSION OF THE DEPARTMENT

VISION

To emerge as a department of excellence in the domain of Electrical and Electronics Engineering producing globally component engineers with research acumen having moral and social values.

MISSION

M1: To offer education with skill-based curriculum through innovative pedagogy, enabling the students to engage in lifelong learning.

M2: To establish industry interactions for creating research-oriented culture to invoke the desire among the students for pursuing successful career.

M3: To maintain sustainable environment of learning in which students acquire knowledge and imbibed with social and ethical values.

PROGRAM EDUCATIONAL OBJECTIVES

Program Educational Objectives of the Electrical and Electronics Engineering provides the following wide aspects in connection with the Vision and Mission of the department.
PEO-1: To pursue higher studies or be employed in Electrical and Electronics Engineering or relevant disciplines.

PEO-2: To analyze real life problems and design Electrical and Electronics Engineering systems with appropriate solutions that are technically sound, economically feasible and socially acceptable.

PEO-3: To exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in lifelong learning.

PROGRAM OUTCOMES

PO1 - Engineering Knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem Analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design/Development of solutions: 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.

PO4 - Conduct investigations of complex problems: 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.

PO5 - Modern tool usage: 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.

PO6 - The engineer and society: 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.

PO7 - Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of engineering practice.

PO9 - Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - Communication: 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.

PO11 - Project management and finance: 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.

PO12 - Life-long learning: 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

PSO1: Able to apply the knowledge of Science, Mathematics & Electrical Engineering fundamentals to solve complex problems in Electrical Machines, Control Systems, Power Systems & Power Electronics.

PSO2: Able to analyze the performance of Electrical Machines, Power Systems and Control Systems.

PSO3: Able to apply the knowledge of ethical & Management principles required to work on a team as well as to lead a team.

KSRM College of Engineering (Autonomous), Kadapa-516005, A.P.

Regulations for UG Programs in Engineering
(R20UG)(Effective from 2020-21)

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KSRM College of Engineering (Autonomous), Kadapa-516005, A.P.

Regulations for UG Programs in Engineering

(R20 UG) (Effective From 2020-21)

1.0 Nomenclature

- **1.1** *Academic Year*: Period of academic instruction of, approximately, one year durationthat usually starts in June/July and ends in April/May next
- **1.2** *Semester*: Either of two divisions of an academic year
- **1.3** *Major*: A specific field of study. Example: Civil Engineering
- **1.4** *Minor*: An area outside of, or complementary to, a Major. Example: For CivilEngineering major, Computer Science is a minor and vice versa
- **1.5** *Subject*: An area of knowledge that is studied as part of a Course
- **1.6** *Core*: A subject that is mandatory for a Major course of study
- **1.7** *Elective*: A subject that is selected for study to suit one's individual needs
- **1.8** *Mandatory Subject*: A subject that is studied to meet certain requirements but has nocredits assigned to it
- **1.9** *Humanities subjects*: Subjects that describe and interpret human achievements, problems and historical changes at individual and societal levels covering the disciplines of literature, history, and philosophy.
- **1.10** *Social Sciences*: Subjects that describe the mental and behavioural activities of individuals, groups, organizations, institutions, and nations covering the disciplines of anthropology, economics, linguistics, political science, and psychology
- **1.11** *Exam*: A test to measure one's progress, knowledge, or ability in a subject
- **1.12** *Credit*: A numerical weight given to a subject, usually based on quantum of academic work
- **1.13** *Grade*: A numerical or alphabetic designation measuring the level of achievement in an exam.
- **1.14** *Attendance*: Physical presence of oneself in a classroom/laboratory for purpose of ascheduled academic instruction
- **1.15** *Course*: A series of subjects that constitute a Major field of study
- **1.16** *Branch*: Same as Course
- **1.17** *Program*: Same as Course
- **1.18** *Degree*: An academic title conferred to honour distinguished achievement
- **1.19** *Minor Degree*: An Academic honour conferred on achieving 20 extra credits in one'sminor area of study
- **1.20** *Honours*: An Academic honour conferred on achieving 20 extra credits in one'smajor area of study.

2.0 Short Title and Application

2.1 These rules and regulations may be called as R20UG and come into force from Academic Year 2020-21 and exists until superseded by new regulations. These rules are applicable for students who join the institute from academic year 2020-21 onwards. Students who have joined in earlier regulations will continue in their respective regulations.

2.2 These rules and regulations are applicable to all under graduate courses in engineering and technology leading to Bachelor's Degree in Technology (B. Tech)

2.3 The Major courses offered, at present, are:

2.3.1 Civil Engineering

2.3.2 Electrical and Electronics Engineering

2.3.3 Mechanical Engineering

2.3.4 Electronics and Communication Engineering

2.3.5 Computer Science and Engineering

2.4 The Institute may offer new Majors in future to which these rules and regulationswill be applicable.

3.0 Suspension and Amendment of Rules

3.1 Academic Council has the authority to suspend a rule temporarily.

3.2 Academic Council has the authority to amend a rule.

3.3 For affirmative action on any suspension or amendment of a rule, an affirmative vote of three-fifths of the members present and voting shall be required in Academic Council.

4.0 Requirements for Admission

4.1 At present, admissions into first-year class of various Majors are governed by Government and the Affiliating University. The eligibility criteria and procedure for admissions are prescribed by Government and Affiliating University.

4.2 A student is not allowed change of Major after admission into first-year.

4.3 A student must fulfil medical standards required for admission.

4.4 The selected students are admitted into first-year class after payment of the prescribed fees.

5.0 Structure of the B. Tech course

5.1 *Duration*: The duration of B. Tech degree course is eight semesters spread over fouracademic years. Semesters are named sequentially from First Semester to Eighth Semester.

5.2 *Working Days*: Calendar for any semester shall be announced at least four weeks before its commencement. Minimum number of working days shall be 90 for any semester.

5.3 *Curriculum*: Each major shall have core, elective and mandatory subjects drawn from six categories of subject areas - i) Basic Sciences (BSC), ii) Humanities and Social Sciences including Management Courses (HSMC), iii) Engineering Science Courses (ESC), iv) Professional Core Course (PCC), v) Professional Elective Course (PEC), and vi) Open Elective Course (OEC). The curriculum for eachbranch shall be approved by its corresponding Board of Studies and Academic Council.

5.4 *Credits*: All subjects that are assessed for marks have credits assigned to them. Thecredits assigned to subjects shall be given in curriculum. The total number of creditsfor entire course is 160 for all branches.

5.5 *Curriculum and Syllabus*: The curriculum and syllabus for first and second semestersis given in Annexure-1 and Annexure-2 respectively.

5.6 *Medium of Instruction*: The medium of instruction, examinations and all other related activities is English.

5.7 *Responsibility and Advising*: It is the responsibility of the student to understand and know the regulations and requirements to earn the degree. Each student admitted into the degree programs is assigned to a Faculty Advisor who assists the student indesigning an effective program of study. Students should consult their Faculty Advisors for selection of electives and for general advice on academic program.

5.8 *Gap-Year*: Outstanding students who wish to pursue entrepreneurship are allowedto take a break of one year at any time after II Year / III Year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. College Academic Council shall evaluate the proposal submitted by the student and decide on permitting the student for availing the gap-year. Gap- year can be availed once in the entire course.

6.0 Registration and Enrolment

6.1 Prior to start of each semester, every student shall register for all the subjects listedin curriculum and additional subjects required for achieving honours/ minor degree. Excepting first semester, the registration for a semester shall be done duringa specified week after end examinations of previous semester. In first semester, theregistration shall be done within six working days from date of joining. Recommendation of Faculty Advisor is needed for registration.

6.2 A student can register utmost 8 theory subjects, including mandatory subjects, in any semester.

6.3 Late registration will be permitted with a fine, decided from time to time, up to sixworking days from the last date specified for registration.

6.4 A student will be eligible for registration for a semester if she or he i) is promoted tothat semester, ii) has cleared all fees to the Institute, library and hostel of previoussemester, and iii) is not disqualified for registration by a disciplinary action.

6.5 A student will be enrolled and allowed to attend the classes on successful registration and payment of necessary fees to Institution, library, and hostel.

6.6 Registration and enrolment will be controlled by the Office of the Controller of Examinations.

7.0 Assessment Procedure – Internal Tests and End Examinations

7.1 Performance of students in all subjects is assessed continuously through assignments, internal assessment tests and an End examination.

7.2 Allocation of internal assessment and End examination marks

7.2.1 For theory subjects, the allocation is 40 marks for internal assessment and60 marks for End examination totalling 100 marks.

7.2.2 For laboratory/drawing/project work subjects, the allocation is 40 marks forinternal assessment and 60 marks for End examination totalling 100 marks.

7.2.3 For seminar/industrial training/internship subjects, the allocation is 100 marks for internal assessment. There is no end examination for these subjects.

7.2.4 For mandatory subjects the allocation is 40 marks for internal assessment and no allocation for End examination. These marks are specified for purpose of clause 9.3, and do not account for any credits.

7.3 Internal Assessment

7.3.1 Internal assessment means performance evaluation of students by faculty members who teach the subjects.

7.3.2 *Guidelines*:

a) *Allocation*: For theory subjects including mandatory subjects the total internal assessment marks is 40 of which 30 marks are assessed through midterm tests, 5 marks by surprise or sudden quiz and 5 marks by assignments. The faculty members of the concerned subject will assess themarks in the midterm tests and assignments.

b) *Midterm tests*: Each midterm test will be of 90 minutes duration and evaluated for 30 marks. Internal assessment marks for midterm tests will be calculated as weighted sum of the two midterm test marks, with 80% weight for the best and 20% weight for the other marks. Internal assessment marks for assignments is calculated as the average of all assignments. Total internal marks are the sum of midterm tests, surprise orsudden quiz and assignments assessment marks.

If any student abstains for any midterm test, she or he will be awarded zeromarks for that midterm test. If any student fails to submit any assignmentwithin the specified deadline, she or he will be awarded zero marks for thatassignment.

i. *Number and duration*: There shall be two midterm tests each with a duration of 90 minutes.
ii. *Format of test and division of marks*: Internal test shall consist of only descriptive part for 30 marks.
iii. *Descriptive or Subjective part*: Subjective part shall contain three questionsand all questions shall be answered. However, each question can have internal choice (either or type question). Generally, each question shall testone Course Outcome (CO).
iv. *Syllabus*: Each test shall cover 50% of the syllabus, approximately.

c) *Assignments*: The assignments shall aid and hone the daily routine of students. Assignments shall be stimulating and thought provoking to the student. Whilesome questions may test student's understanding of the subject, there shall bequestions that imply connect to real world applications. A variety of questionscan posed in assignments.

i. *Number:* A minimum of four assignments shall be given in each subject with one assignment from Unit I to IV of syllabus of that subject.
ii. *Quantum of work*: An assignment shall take about four to six hours of study / work per week. Assignments shall not be overloaded nor under loaded. As a guideline, each assignment may contain five questions, each question taking an hour to answer.
iii. *Marks*: Each assignment must be evaluated for fifty marks. Final marks areobtained by averaging all the assignment marks and reducing it to five marks.
iv. *Deadlines*: Students shall be given at least one-week time to complete and submit assignments. Assignments shall be submitted within deadline. Latesubmissions should be awarded zero marks.
v. *General*: It is advised to administer assignments using Google Classroom.

d) *Quiz*: The concerned faculty has to conduct 8 surprise quiz exams in the regular class itself. From each unit two quiz exams shall be conducted and each quiz is for 10 marks. Out of 8 quizzes 6 best quizzes shall be considered and average of 6 quizzes will be reduced to 5 marks. Each quiz can be fill in the blanks or single sentence answer or definitions.

7.3.3 For laboratory/practical/drawing subjects, the internal assessment will be based on regular laboratory work over full semester. The assessment will bedone by the faculty concerned. The students shall be informed sufficiently early of the procedure to be followed for internal assessment.

7.3.4 For subjects like seminar, project-work, industrial training/internship, andcomprehensive viva-voce, the internal assessment will be done by a Department Committee consisting of two senior faculty members and faculty guide of concerned student. The assessment procedure will be informed sufficiently early to the students.

a) *Mandatory internships*: University Guidelines shall apply.
b) *Evaluation of internships*: Shall be evaluated through the departmental committee. A student will be required to submit a summer internship report to the concerned department and appear for an oral presentation before the department committee. The report and the oral presentation shall carry 40% and 60% weightages respectively.
c) *Final Semester Internship*: A student should mandatorily undergo internship (University Guidelines shall apply) and should work parallelly on a project. At the end of the semester the candidate shall submit an internship completion certificate and a project report. The project report shall be evaluated with an external examiner.

7.3.5 After the course work is over, the student is permitted to improve his/her internal marks of any 3 theory subjects in the entire course. However he/she will have to attend the course work.

7.4 End examinations

7.4.1 End examinations shall be conducted after completion of coursework in each semester. End exams assessment is for 60 marks. The question paper contains 5 questions and all questions shall be answered. Each question have internal choice (either or type question). Each question carries 12 marks.

7.4.2 The question papers for theory subjects shall be set by faculty members outside of the Institute. The external faculty members for question paper setting shall be appointed by the Principal.

7.4.3 Evaluation of answer scripts shall be done by either Internal or External examiners appointed by the Principal. A minimum of 50% of subjects will beevaluated by external examiners.

7.4.4 For laboratory subjects, end examination shall be conducted by a committee consisting of two internal examiners. One examiner shall be appointed by Head of Department of concerned Major, and the other examiner shall be appointed by the Principal.

7.4.5 For project work viva-voce, end examination shall be conducted by a committee consisting of one internal examiner, one external examiner, and the concerned guide of the student. Internal examiner shall be appointed by Head of Department of concerned Major, and the external examiner shall be appointed by the Principal.

7.4.6 If a student abstains from End examination of any subject, for any reason, sheor he shall be marked as "ABSENT" in that subject.

7.4.7 There is no end examination for mandatory subjects.

8.0 Method of Assigning Letter Grades and Grade Points

8.1 For all credit-bearing subjects, performance of a student in a subject is indicated bya letter grade that corresponds to absolute marks earned in that subject. Each lettergrade is assigned a numeric Grade Point that is used to compute Grade Point Average on a scale of 0 to 10.

8.2 Performance of a student in both internal assessment and End examination will be considered for awarding grades for credit bearing subjects. Total marks earned in asubject is the sum of marks obtained in internal assessment and End examination in that subject.

8.3 Pass grade S to E is assigned to a subject based on total marks earned in that subject provided that a student earns at least i) 35% of marks in End examination,and ii) 40% of marks in internal assessment and End examination put together; otherwise fail grade F will be assigned to that subject.

8.4 Grade I will be assigned to a subject if a disciplinary action is pending and is not resolved before publication of results. Office of Controller of Examinations shall resolve the pending disciplinary action within six working days from the date of publication of results and change the grade to any of S to F.

8.5 Grade *Ab* will be assigned to a subject if a student abstains for End examination ofthat subject.

8.6 The absolute marks and corresponding letter grade and grade points are given in Table 1.

Table 1: Letter Grades and Grade Points

Absolute Marks	Letter Grade	Grade Points assigned	Remark
≥ 90	S (Outstanding)	10	Pass
80 - 89	A (Excellent)	9	Pass
70 - 79	B (Very Good)	8	Pass
60 - 69	C (Good)	7	Pass

50 - 59	D (Average)	6	Pass
40 - 49	E (Below Average)	5	Pass
< 40	F (Fail)	0	Fail
Absent	Ab (Absent)	0	Fail
-	I	0	Result Withheld

8.7 *SGPA*: Semester Grade Point Average indicates the performance of a student in allcredit-bearing subjects of a semester. SGPA is calculated as the weighted average ofGrade Points of all subjects of the semester with corresponding credits of subjects as weights. Audit and Self-study subjects are not considered for SGPA calculation

$$SGPA = \frac{\sum GP_i \times CR_i}{\sum CR_i}$$

where GP_i = Grade Point earned in a subjectand CR_i = Credits allocated for that subject

8.8 *CGPA*: Cumulative Grade Point Average indicates the performance of a student in all semesters up to and including the current semester under consideration. CGPAis calculated as the weighted average of SGPAs with total credits in each semester as the weights.

$$CGPA = \frac{\sum S_i \, X \, TC_i}{\sum TC_i}$$

where S_i = SGPA obtained in a semesterand TC_i = Total Credits for that semester

8.9 As per AICTE regulations, conversion of CGPA into equivalent percentage is asfollows:

Equivalent Percentage = (CGPA – 0.50) □ 10

8.10 In *SGPA / CGPA* calculations credits earned towards honours / minor degree will not be counted.

8.11 *Grade Card*: All students shall be issued Grade Cards after the publication of results of a semester. Grade Card is a statement of performance of a student in a semester. It contains information about each registered subject: type of subject, allocated credits, and letter grade earned. SGPA and CGPA will also be indicated.

9.0 Requirements for Completing Subjects

9.1 A student shall complete all credit-bearing and mandatory subjects successfully tobe eligible for award of degree.

9.2 *Credit-bearing subjects*: A student is considered to have completed a credit-bearing subject successfully and earned credits if she or he obtains a pass grade from S to Ein that subject. If a student receives fail grade F or *Ab* in any subject, she or he mustregister for supplementary End examination for that subject as and when opportunity arises and improve grade to pass grade.

9.3 *Mandatory subjects*: A student is considered to have successfully completed a mandatory subject if she or he earns at least 40% of internal assessment marks in that subject.

9.4 *Supplementary exam for mandatory subjects*: If a student fails in mandatory subject, she or he shall register for supplementary examination in that subject as and when theopportunity arises and pass that subject. The supplementary exam will be conducted for 30 marks covering the entire syllabus and student is deemed to havepassed in the subject if she or he earns 12 marks (40% marks) in the supplementaryexam, disregard of her or his performance in assignments and internal tests.

10.0 Requirements for taking End Examinations and Promotion

10.1 A student is eligible to take regular End Examinations of current semester if she orhe fulfils the attendance requirement.

10.2 A student shall be promoted from current semester to succeeding semester onsatisfying the attendance and total credits-earned requirements.

10.3 Attendance Requirement

10.3.1 Attendance of students shall be recorded for credit-bearing and mandatory subjects as per the work load indicated in curriculum.

10.3.2 Total class-periods conducted shall be reckoned from beginning to end of asemester as published in academic calendar.

10.3.3 Aggregate Percentage of Attendance is calculated using total number of class-periods attended as numerator and total number of class-periodsconducted for the concerned semester as the denominator.

10.3.4 A minimum aggregate attendance of 75% is required for promotion to succeeding semester and be eligible to take End examinations of current semester. In addition, student has to acquire a minimum of 40% attendancein each subject.

10.3.5 A student can appeal to the Principal for condoning deficiency in aggregate attendance if she or he gets an aggregate attendance of 65% or more but lessthan the required 75%, presenting a valid reason for deficiency. Such a student will be granted promotion if the Principal pardons the deficiency. Principal has the right to reject the appeal if he/she is not satisfied with theperformance of the student or the reason cited for deficiency of the attendance.

10.3.6 A student earning less than 65% aggregate attendance will be denied promotion. A student who is not promoted on basis of attendance shall be removed from the rolls and shall register for the same semester when opportunity arises. The current semester record of the student is cancelled automatically.

10.4 Credits-Earned Requirement

10.4.1 This rule is applicable for promotion of a student from fourth semester to fifth semester and from sixth semester to seventh semester.

10.4.2 A student who is denied promotion for want of requisite credits shall take supplementary examinations, as and when offered, and earn credits to be eligible for promotion.

10.4.3 Subjects registered for honours/minor degree shall not be considered towards credits-earned requirement.

10.4.4 For promotion from fourth semester to fifth semester, a student must earn atleast 40% credits (rounded to lower integer) from first semester to third semester subjects. A student will get the following opportunities to pass the subjects:

First semester subjects	: One regular and three supplementary exams
Second semester subjects	: One regular and two supplementary exams
Third semester subjects	: One regular and one supplementary exam

10.4.5 For promotion from sixth semester to seventh semester, a student must earn at least 40% credits (rounded to lower integer) from first semester to fifth semester subjects. A student will get the following opportunities to pass the subjects:

First semester subjects	: One regular and five supplementary exams
Second semester subjects	: One regular and four supplementary exams
Third semester subjects	: One regular and three supplementary exams
Fourth semester subjects	: One regular and two supplementary exams
Fifth semester subjects	: One regular and one supplementary exam

11.0 Revaluation of End Examination Scripts

11.1 Revaluation of End Examination scripts is allowed for theory subjects only by paying requisite fee.

11.2 Procedure for Revaluation: The script will be revaluated by an examiner appointed by the Principal. The maximum of revaluation and regular end examination marks will be awarded for that subject.

11.3 A student can apply for revaluation in a subject only once.

12.0 Supplementary End Examinations

12.1 Students are eligible to take Supplementary examinations in subjects with fail gradeeither F or *Ab* only.

12.2 Supplementary examinations for even semester subjects will be conducted along with regular examinations of odd semester subjects.

12.3 Supplementary examinations for odd semester subjects will be conducted along with regular examinations of even semester subjects.

12.4 For eighth semester, special supplementary examinations will be conducted in second week following the results publication date of regular examination of eighthsemester.

13.0 Requirements for Award of B. Tech degree

13.1 Time Limit for completion of requirements for award of degree is eight academic years including gap-year from the date of admission. A student who could not complete all the requirements in this time limit shall forego admission and will beremoved from the rolls of the Institute.

13.2 A student shall be eligible for award of B. Tech degree provided she or he has:

13.2.1 Registered and successfully completed all required credit-bearing and mandatory subjects with a total of 160 credits

13.2.2 Secured a CGPA of 4.5 or more

13.2.3 Cleared all dues to the Institute, library and hostel

13.2.4 No disciplinary action is pending against her or him

13.2.5 Satisfied any other stipulation of the affiliating university.

13.3 *Award of Class*: Each student will be given class in degree based on CGPA asfollows:

Table 2: Class of Degree

Class of Degree	Range of CGPA
Pass Class	>= 4.5 but <5.5
Second Class	>= 5.5 but <6.5
First Class	>= 6.5 but <7.5
First Class with Distinction	>= 7.5

13.4 *Degree with Honours designation*: Students with higher learning capabilities are encouraged to opt for Honours designation. Degree with Honours imply a higher level of academic achievement. A student can earn B.Tech degree with honours designation by meeting the following requirements

13.4.1 Honours designation is optional. A student can opt for either Honours designation or Minor degree (clause 13.5) but not both.

13.4.2 *Entry eligibility*: Students shall apply for Honours designation at the beginning of the fourth semester. Eligibility criteria are (i) minimum CGPA of 8.0 and (ii) no backlogs, reckoned up to second semester. The Chairperson of the concerned Board of Studies will process the applications and publish the list of eligible students.

13.4.3 *Additional course work*: Students shall complete an additional 20-credits coursework, in addition to 160 regular credits, in her/his own major during fifth to seventh semesters. The Board of Studies (BoS) of the concerned major shall specify the list of advanced elective subjects for the purpose of honours designation.

Out of the 20 additional credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through twoMOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12 weeks as recommended by the BoS.

If minimum enrolments criteria are not met then the students shall be permitted to register for the equivalent MOOC courses as approved by theconcerned Head of the department in consultation with BoS.

If a student drops or is terminated from the Honours program, the additional credits earned so far will remain extra. These additional courses will find mention in the transcript but not in the degree certificate.

13.4.4 *Registration and enrollment*: Clause 6.0 shall apply

13.4.5 *Evaluation*: The evaluation shall be as per clause 7.0

13.4.6 *Continuous performance*: Students shall earn a minimum SGPA of 8.0 in allsemesters, from fourth to seventh, and without backlogs to be eligible for award of Honours designation. Regular and additional subjects shall be considered for SGPA calculation. If a student does not get a minimum SGPA of 8.0 or fails in any subject during fourth to seventh semesters, she/he will lose candidature for honours designation.

13.5 *Minor Degree designation*: Students with higher learning capabilities are encouraged to opt for Minor degree designation. Minor degree imply a higher level of academic achievement and improves employability. A student can earn minor degree designation by meeting the following requirements.

13.5.1 Minor degree is optional. A student can opt for either Minor degree or Honours designation (clause 13.4) but not both.

13.5.2 *Entry eligibility*: Students shall apply for minor degree at the beginning of fourth semester. Eligibility criteria are (i) minimum CGPA of 8.0 and (ii) no backlogs, reckoned up to second semester.

The Chairperson of the concerned Board of Studies (minor department) will process the applications and publish the list of eligible students.

13.5.3 *Additional coursework*: Students shall complete an additional 20-credits coursework, in addition to 160 regular credits, in selected minor program during fourth to seventh semesters. The Board of Studies (BoS) of the concerned minor program shall specify the list of core and elective subjects for the purpose of minor degree. Out of the 20 credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS and must pursue atleast 2 courses through MOOCs.

13.5.4 *Registration and enrollment*: Clause 6.0 shall apply.

13.5.5 *Evaluation*: The evaluation shall be as per clause 7.0.

13.5.6 *Continuous performance*: Students shall earn a minimum SGPA of 8.0 in all semesters, from fourth to seventh, and without backlogs to be eligible for award of minor degree. Regular and additional subjects shall be considered for SGPA calculation. If a student does not get a minimum SGPA of 8.0 or fails in any subject during fourth to seventh semesters, she/he will lose candidature for minor degree.

13.6 Degree will be issued under the seal of affiliating University.

14.0 Regulations for Lateral Entry Students under R20 UG

Title and application: These rules and regulations may be called R20UG-LE and come into force from academic year 2021-22 and exist in force until superseded by other regulations. These regulations are applicable to students admitted under lateral entry scheme leading to Bachelor's Degree in Technology (B.Tech).

a) *Regulations and curriculum*: The regulations and curriculum of R20UG shall be applicable in general with the following modifications:

  i. *Entry and duration*: The students will be admitted directly into third semester of regular 4-year B.Tech degree course governed by R20UG regulations. The duration of the course is three academic years.

  ii. *Curriculum*: Third semester to eighth semester curriculum of R20UG.

  iii. *Promotion by credits-earned requirement*: This is applicable for the promotion of a student from sixth semester to seventh semester only. She/he must earn at least 40% of total credits (rounded to lower integer) from third to fifth semesters for promotion from sixth semester to seventh semester.

b) Requirements for the award of B.Tech degree:

  i. Time limit for completion of requirements for award of degree is six academic years from the date of admission.

  ii. Registered and successfully completed all required credit-bearing and mandatory subjects with a total of 121 credits. (third semester to eighth semester subjects)

  iii. *Honours/minors designation*: shall earn extra 20 credits in addition to 121 credits.

15.0 Transitory Regulations

15.1 A student who initially joins the Institute in a previous Regulation and has to re- join in a semester of the present Regulations, due to any reason, shall be bound by the rules of the current Regulations. Board of Studies of the concerned Major will specify, extra or otherwise, academic coursework to be undertaken by such students who join the current Regulations.

KSRM COLLEGE OF ENGINEERING (AUTONOMOUS)
VISION & MISSION

VISION:

To evolve as center of repute for providing quality academic programs amalgamated with creative learning and research excellence to produce graduates with leadership qualities, ethical and human values to serve the nation.

MISSION:

M1: To provide high quality education with enriched curriculum blended with impactful teaching-learning practices.

M2: To promote research, entrepreneurship and innovation through industry collaborations.

M3: To produce highly competent professional leaders for contributing to Socio-economic development of region and the nation.

ELECTRICAL AND ELECTRONICS ENGINEERING

VISION:

To emerge as a department of excellence in the domain of Electrical and Electronics Engineering producing globally competent engineers with research acumen having moral and social values.

MISSION:

M1: To offer education with skill-based curriculum through innovative pedagogy, enablingthe students to engage in lifelong learning.

M2: To establish industry interactions for creating research-oriented culture to invoke thedesire among the students for pursuing successful career.

M3: To maintain sustainable environment of learning in which students acquire knowledge and imbibed with social and ethical values.

PROGRAM EDUCATIONAL OBJECTIVES

Program Educational Objectives of the Electrical and Electronics Engineering provides thefollowing wide aspects in connection with the Vision and Mission of the department.

- To pursue higher studies or be employed in Electrical and Electronics Engineering or relevant disciplines.
- To analyze real life problems and design Electrical and Electronics Engineering systems with appropriate solutions that are technically sound, economically feasible and socially acceptable.
- To exhibit professionalism, ethical attitude, communication skills, team work in their profession and adapt to current trends by engaging in lifelong learning.

PROGRAMME OUTCOMES

PO1 - Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2 - Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3 - Design/development of solutions: 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.

PO4 - Conduct investigations of complex problems: 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.

PO5 - Modern tool usage: 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.

PO6 - The engineer and society: 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.

PO7 - Environment and sustainability: Understand the impact of the professional engineeringsolutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO8 - Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9 - Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10 - Communication: 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.

PO11 - Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member andleader in a team, to manage projects and in multidisciplinary environments.

PO12 - Life-long learning: 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.

PROGRAMME SPECIFIC OUTCOMES

PSO1: Able to apply the knowledge of Science, Mathematics; Electrical and Electronics Engineering fundamentals to solve complex problems in Electrical Machines, Control Systems, Power Systems and Power Electronics.

PSO2: Able to analyze the performance of Electrical Machines, Power Systems andControl Systems.

PSO3: Able to apply the knowledge of ethical and management principles required towork on a team as well as to lead a team.

ELECTRICAL AND ELECTRONICS ENGINEERING

Course Structure

I Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2021101	Linear Algebra and Calculus	BSC	3	0	0	40	60	3
2	20AP102	Applied Physics	BSC	3	0	0	40	60	3
3	2024103	Communicative English	HSMC	3	0	0	40	60	3
4	2005103	C-Programming & Data Structures	ESC	3	0	0	40	60	3
5	2003105	Engineering Drawing	ESC	1	0	2	40	60	2
6	2003106	Engineering Drawing Lab	ESC	0	0	2	40	60	1
7	20AP107	Applied Physics Lab	BSC	0	0	3	40	60	1.5
8	2024108	Communicative English Lab	HSMC	0	0	3	40	60	1.5
9	2005108	C-Programming & Data Structures Lab	ESC	0	0	3	40	60	1.5
Total				**13**	**00**	**13**	**310**	**590**	**19.5**

L - Lecture, T - Tutorial, P – Practical

II Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2021201	Differential Equations & Vector Calculus	BSC	3	0	0	40	60	3
2	2023202	Chemistry	BSC	3	0	0	40	60	3
3	2002203	Electrical Circuits Analysis-I	ESC	3	0	0	40	60	3
4	2004204	Electronic Devices & Circuits	ESC	3	0	0	40	60	3
5	20EW205	Engineering Workshop	ESC	0	0	3	40	60	1.5
6	2005206	IT Workshop	ESC	0	0	3	40	60	1.5
7	2023207	Chemistry Lab	BSC	0	0	3	40	60	1.5
8	2002208	Electrical Circuits Analysis-I Lab	ESC	0	0	3	40	60	1.5
9	2004209	Electronic Devices & Circuits Lab	ESC	0	0	3	40	60	1.5
10	20MC210	Environmental Science	MC	2	0	0	40	00	0.0
Total				**15**	**00**	**10**	**350**	**580**	**19.5**

III Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2002301	Switching Theory & Logic Design	PCC	3	0	0	40	60	3
2	2002302	Electromagnetic Field Theory	PCC	3	0	0	40	60	3
3	2002303	Electrical Circuit Analysis - II	PCC	3	0	0	40	60	3
4	2002304	Electrical Measurements & Measuring Instruments	PCC	3	0	0	40	60	3
5	2002305	DC Machines & Transformers	PCC	3	0	0	40	60	3
6	2002306	Electrical Circuit Analysis - II Lab	PCC	0	0	3	40	60	1.5
7	2002307	Electrical Measurements & Measuring Instruments Lab	PCC	0	0	3	40	60	1.5
8	2002308	DC Machines & Transformers Lab	PCC	0	0	3	40	60	1.5
9	2002309	Skill Oriented Course	SC	1	0	2	40	60	2.0
10	20MC310	Human Values & Professional Ethics	MC	2	0	0	40	00	0.0
Total				**18**	**00**	**11**	**400**	**540**	**21.5**

IV Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2021401	Special Functions & Complex Analysis	BSC	3	0	0	40	60	3
2	2025402	Fundamentals of Management for Engineers	HSMC	3	0	0	40	60	3
3	2002403	Induction Motors & Synchronous Machines	PCC	3	0	0	40	60	3
4	2002404	Linear Control Systems	PCC	3	0	0	40	60	3
5	2002405	Power Systems - I	PCC	3	0	0	40	60	3
6	2002406	Induction Motors & Synchronous Machines Lab	PCC	0	0	3	40	60	1.5
7	2002407	Control Systems Lab	PCC	0	0	3	40	60	1.5
8	2005408	Python Programming Lab	ESC	0	0	3	40	60	1.5
9	2002409	**Skill Oriented Course**	SC	1	0	2	40	60	2.0
Total				**16**	**00**	**11**	**360**	**540**	**21.5**

V Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2002501	Linear Digital IC Applications	PCC	3	0	0	40	60	3
2	2002502	Power System - II	PCC	3	0	0	40	60	3
3	2002503	Power Electronics	PCC	3	0	0	40	60	3
		PEC-I							
4	2002504	Internet of Things	PEC-I	3	0	0	40	60	3
	2002505	Modern Control Theory							
	2002506	Energy Conversion Systems							
5		**Open Elective-1**							
		Courses offered by: **Civil engineering**							
	20CE101	Disaster management	OEC-1	3	0	0	40	60	3
	20CE102	Basics of Civil Engineering	OEC-1	3	0	0	40	60	3
	20CE103	Building Materials	OEC-1	3	0	0	40	60	3
		Courses offered by: **Mechanical Engineering**							
	20OE301	Introduction to Hybrid and Electric Vehicles	OEC-1	3	0	0	40	60	3
	20OE302	Rapid Prototyping	OEC-1	3	0	0	40	60	3
	20OE303	Design for Manufacturing and Assembly	OEC-1	3	0	0	40	60	3
	20OE304	Energy Systems Engineering	OEC-1	3	0	0	40	60	3
	20OE305	Smart Materials	OEC-1	3	0	0	40	60	3
		Courses offered by: **Electronics and Communication Engineering**							
	20OE401	Overview of Microcontrollers	OEC-1	3	0	0	40	60	3
	20OE402	Industrial electronics	OEC-1	3	0	0	40	60	3
		Courses offered by: **Computer Science and Engineering**							
	20OE501	Data Structures	OEC-1	3	0	0	40	60	3
	20OE502	Database Management Systems	OEC-1	3	0	0	40	60	3
		Courses offered by: **Artificial Intelligence and Machine Learning**							
	20OE3901	Data Structures	OEC-1	3	0	0	40	60	03
	20OE3902	OOP through C++	OEC-1	3	0	0	40	60	03
		Courses offered by: **Humanities and Sciences**							
	20OE601	Employability Skills	OEC-1	3	0	0	40	60	03
	20OE602	Advanced Numerical Methods	OEC-1	3	0	0	40	60	03
	20OE604	Basics of Nanotechnology	OEC-1	3	0	0	40	60	03
	20OE605	Write it Right	OEC-1	3	0	0	40	60	03
	20OE606	Human Capital Management	OEC-1	3	0	0	40	60	03
	20OE607	Engineering Materials	OEC-1	3	0	0	40	60	03
6	2002507	Power Systems - I Lab	PCC	0	0	3	40	60	1.5
7	2002508	Internet of Things Lab	PCC	0	0	3	40	60	1.5
8	2025509	Soft Skill Oriented Course	SC	1	0	2	40	60	2.0

9	2002510	Community Service Project	PROJ	0	0	0	100	00	1.5
10	20MC512	Constitution of India	MC	2	0	0	40	00	00
		Total		**18**	**00**	**08**	**60**	**480**	**21.5**

VI Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2002601	Microprocessor & Microcontrollers	PCC	3	0	0	40	60	3
2	2002602	Fundamentals of Electric Drives	PCC	3	0	0	40	60	3
3	2002603	Switchgear & Protection	PCC	3	0	0	40	60	3
		PEC-II							
4	2002604	Power System Operation & Control	PEC-II	3	0	0	40	60	3
	2002605	HVDC Transmission							
	2002606	Signals & Systems							
5		**Open Elective-2**							
		Courses offered by: **Civil Engineering**							
	20CE104	Solid Waste Management	OEC-2	3	0	0	40	60	3
	20CE105	Estimation and Costing	OEC-2	3	0	0	40	60	3
	20CE106	Water management	OEC-2	3	0	0	40	60	3
		Courses offered by: **Mechanical Engineering**							
	20OE306	Automotive Electronics, Sensors & Drives	OEC-2	3	0	0	40	60	3
	20OE307	Robotics and Applications in Manufacturing	OEC-2	3	0	0	40	60	3
	20OE308	Sensors in Intelligent Manufacturing	OEC-2	3	0	0	40	60	3
	20OE309	Non-Conventional Sources of Energy	OEC-2	3	0	0	40	60	3
	20OE310	Supply Chain Management	OEC-2	3	0	0	40	60	3
		Courses offered by: **Electronics and Communication Engineering**							
	20OE403	Introduction to VLSI	OEC-2	3	0	0	40	60	3
	20OE404	Principles of Communication	OEC-2	3	0	0	40	60	3
		Courses offered by: **Computer Science and Engineering**							
	20OE503	Java Programming	OEC-2	3	0	0	40	60	3
	20OE504	Web Designing	OEC-2	3	0	0	40	60	3
		Courses offered by: **Artificial Intelligence and Machine Learning**							
	20OE3903	Operating Systems	OEC	3	0	0	40	60	03

	20OE3904	Data Base Management Systems	OEC	3	0	0	40	60	03
	Courses offered by: **Humanities and Sciences**								
	20OE603	Mathematical Statistics for Data Science and Data Analytics	OEC	3	0	0	40	60	03
	20OE608	Basics of Electrical, Magnetic and Optoelectronic materials	OEC	3	0	0	40	60	03
	20OE609	Corrosion & Control	OEC	3	0	0	40	60	03
	20OE615	Academic Writing	OEC	3	0	0	40	60	03
	20OE611	Basics Financial Management for Engineers	OEC	3	0	0	40	60	03
6	2002607	Power Electronics Lab	PCC	0	0	3	40	60	1.5
7	2002608	Power System- II Lab	PCC	0	0	3	40	60	1.5
8	2004609	Advanced Programming Lab	ESC	0	0	3	40	60	1.5
9	2002610	Skill Advanced Course	SC	1	0	2	40	60	2.0
10	20MC612	Management Organizational Behavior	MC	2	0	0	40	00	00
		Total		**18**	**00**	**08**	**60**	**480**	**21.5**

VII Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
		PEC-III							
1	2002701	Power Quality	PEC-III	3	0	0	40	60	3
	2002702	Electric and Hybrid Vehicles							
	2002703	Power System Reliability							
		PEC-IV							
2	2002704	Power Electronics For Renewable Energy Systems	PEC-IV	3	0	0	40	60	3
	2002705	Electrical Distribution Systems							
	2002706	Smart Grid							
		PEC-V							
3	2002707	Flexible AC Transmission Systems	PEC-V	3	0	0	40	60	3
	2002708	Industrial Automation & Control							
	2002709	Distributed Generation & Micro Grid							
4	**Open Elective-3**								
	Courses offered by: **Civil Engineering**								
	20CE107	Repair and rehabilitation of structures	OEC-3	3	0	0	40	60	3

	20CE108	Geo-environmental engineering	OEC-3	3	0	0	40	60	3
	20CE109	Environmental impact assessment	OEC-3	3	0	0	40	60	3
	Courses offered by: **Mechanical Engineering**								
	20OE311	Entrepreneurship	OEC-3	3	0	0	40	60	3
	20OE312	Solar Energy Systems	OEC-3	3	0	0	40	60	3
	20OE313	Internal Combustion Engine	OEC-3	3	0	0	40	60	3
	Courses offered by: **Electronics and Communication Engineering**								
	20OE405	Electronic Instrumentation and measurements	OEC-3	3	0	0	40	60	3
	20OE406	Introduction to IOT	OEC-3	3	0	0	40	60	3
	20OE407	Nano Electronics	OEC-3	3	0	0	40	60	3
	Courses offered by: **Computer Science and Engineering**								
	20OE505	Operating System	OEC-3	3	0	0	40	60	3
	20OE506	R Programming	OEC-3	3	0	0	40	60	3
	Courses offered by: **Artificial Intelligence and Machine Learning**								
	20OE3905	Cyber Security	OEC-3	3	0	0	40	60	03
	20OE3906	Java Programming	OEC-3	3	0	0	40	60	03
	Courses offered by: **Humanities and Sciences**								
	20OE612	Transforms and Its Applications	OEC-3	3	0	0	40	60	3
	20OE613	Physics of Renewable Energy	OEC-3	3	0	0	40	60	3
	20OE614	Fuel Technology	OEC-3	3	0	0	40	60	3
	20OE615	Professional Communication	OEC-3	3	0	0	40	60	3
	20OE616	Digital and Social Media Management	OEC-3	3	0	0	40	60	3
5	**Open Elective -4**								
	Courses offered by: **Civil Engineering**								
	20OE110	Industrial safety engineering	OEC-4	3	0	0	40	60	3
	20OE111	Surveying	OEC-4	3	0	0	40	60	3
	20OE112	Traffic Engineering	OEC-4	3	0	0	40	60	3
	Courses offered by: **Mechanical Engineering**								
	20OE314	Energy Auditing	OEC-4	3	0	0	40	60	3
	20OE315	Sustainable Engineering	OEC-4	3	0	0	40	60	3
	20OE316	Industrial Engineering & Management	OEC-4	3	0	0	40	60	3
	Courses offered by: **Electronics and Communication Engineering**								
	20OE408	Fundamentals of RADAR Engineering.	OEC-4	3	0	0	40	60	3

	20OE409	Biomedical Instrumentation	OEC-4	3	0	0	40	60	3
	20OE410	Digital Circuits	OEC-4	3	0	0	40	60	3
	Courses offered by: **Computer Science and Engineering**								
	20OE508	Python Programming	OEC-4	3	0	0	40	60	3
	20OE509	Cloud Computing	OEC-4	3	0	0	40	60	3
	Courses offered by: **Artificial Intelligence and Machine Learning**								
	20OE3907	Data Analytics with Python	OEC-4	3	0	0	40	60	3
	20OE3908	Web Designing using PHP	OEC-4	3	0	0	40	60	3
	Courses offered by: **Humanities and Sciences**								
	20OE617	Operations Research	OEC-4	3	0	0	40	60	3
	20OE618	Fundamentals of Quantum Computation and Nano photonics	OEC-4	3	0	0	40	60	3
	20OE619	Green Chemistry & Technology	OEC-4	3	0	0	40	60	3
	20OE620	Creative Writing	OEC-4	3	0	0	40	60	3
	20OE621	Materials Management	OEC-4	3	0	0	40	60	3
Courses offered by: Humanities Elective course									
6	2006701	Human Resources and Development	HSS	3	0	0	40	60	3
	2006702	Digital Marketing							
	2006703	Project Management							
7	2002710	Internship	PROJ	0	0	0	100	---	03
8	2002711	Skill Advanced Course	SC	1	0	2	40	60	02
		Total		**19**	**00**	**02**	**380**	**420**	**23**

VIII Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2002801	Project Work	PROJ	-	-	-	40	60	12
		Internship in Industry							
		Total		**-**	**-**	**-**	**40**	**60**	**12**

B.Tech I SEM EEE (R20)

<table>
<tr><td>Course Title</td><td colspan="5">Linear Algebra and Calculus</td><td colspan="3">B.Tech EEE I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2021101</td><td rowspan="2">Basic Science Course (BSC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn concepts of Matrices, Mean value Theorem, Multivariable Calculus, Multiple Integrals and Beta, Gamma functions. Using these concepts the students can analyze their engineering applications.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Define Beta and Gamma functions</td></tr>
<tr><td>CO 2</td><td colspan="8">Classify the functions of several variables which are useful in optimization techniques.</td></tr>
<tr><td>CO 3</td><td colspan="8">Evaluate multiple integrals</td></tr>
<tr><td>CO 4</td><td colspan="8">Utilize mean value theorems to real life problems</td></tr>
<tr><td>CO 5</td><td colspan="8">Develop the matrix algebra techniques for practical applications.</td></tr>
</table>

UNIT- I

Matrices: Rank of a matrix by Echelon form, Normal form. Solving systems of homogeneous and non- homogeneous linear equations. Eigenvalues and Eigenvectors for real matrices – Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley–Hamilton theorem. Diagonalisation by orthogonal transformation.

UNIT-II

Mean Value Theorems: Rolle’s theorem, Lagrange’s mean value theorem, Cauchy’s mean value theorem, Taylor’s and Maclaurin’s theorems with remainders (without proof), related problems.

UNIT- III

Multivariable Calculus: Partial derivatives, total derivative, chain rule, change of variables, Jacobians, Maxima and minima of functions of two variables – Lagrange’s method of undetermined multipliers.

UNIT- IV

Multiple Integrals: Evaluation of double integrals in Cartesian coordinates and polar coordinates – Change of variables in double integrals – Change the order of integration in double integrals – Evaluation of triple integrals in Cartesian and polar coordinates – Change of variables between cartesian, cylindrical and spherical polar coordinates.

UNIT-V

Beta and Gamma functions: Beta and Gamma functions and their properties, relation between Beta and Gamma functions, evaluation of definite integrals using Beta and Gamma functions.

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-43 edition 2014.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 9th edition-2013.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, Mc. Graw Hill Education (India) Pvt. Ltd, New Delhi, 11th Edition, Reprint 2010.
2. Linear Algebra: A Modern Introduction, D Poole, 2nd Edition, Brooks/Cole, 2005.
3. A Textbook of Engineering Mathematics, N.P. Bali and Manish Goyal, Lakshmi Publications, Reprint 2008.

Course Title	Applied Physics					B.Tech EEE I Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20AP102	**Basic Science Course (BSC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration : 2Hrs						**End Exam Duration : 3Hrs**		

Course Objectives: The objective of the course is to learn optical phenomenon i.e. interference, diffraction, the mechanisms of emission of light, the use of lasers as light sources for low and high energy applications, concepts of dielectric and magnetic materials, Quantum Mechanics, semiconductors and superconductors.

Course Outcomes: On successful completion of this course, the students will be able to,

CO 1	Study the different realms of physics and their applications in both scientific and technological systems through physical optics
CO 2	Identify the wave properties of light and the interaction of energy with the matter
CO 3	Assess the electromagnetic wave propagation and its power in different media
CO 4	Understands the response of dielectric and magnetic materials to the applied electric and magnetic fields
CO 5	Study the quantum mechanical picture of subatomic world along with the discrepancies between the classical estimates and laboratory observations of electron transportation phenomena by free electron theory and band theory
CO 6	Elaborate the physical properties exhibited by materials through the understanding of properties of semiconductors and superconductors

UNIT- I

Wave Optics

Interference: Principle of superposition – Interference of light – Conditions for sustained interference - Interference in thin films (Reflection Geometry) – Colors in thin films – Newton’s Rings – Determination of wavelength and refractive index.

Diffraction: Introduction – Fresnel and Fraunhofer diffraction – Fraunhofer diffraction due to single slit, double slit and N-slits (qualitative)-- – Grating spectrum.

UNIT-II

Lasers and Fiber optics

Lasers: Introduction – Characteristics of laser – Spontaneous and Stimulated emission of radiation – Einstein's coefficients – Population inversion – Lasing action – Pumping mechanisms – Nd-YAG laser – He-Ne laser – Semiconductor diode laser- Applications of lasers.

Fiber optics: Introduction – Principle of optical fiber – Acceptance Angle – Numerical Aperture – Classification of optical fibers based on refractive index profile and modes – Block diagram of Optical fiber Communication system – Propagation Losses (qualitative) – Applications.

UNIT-III

Dielectric and Magnetic Materials

Dielectric Materials: Introduction – Dielectric polarization – Dielectric polarizability, Susceptibility and Dielectric constant – Types of polarizations: Electronic, Ionic and Orientation polarizations (Qualitative) – Lorentz internal field – Claussius- Mossotti equation.

Magnetic Materials: Introduction to magnetic materials (Origin of magnetic moment of an atom and Classification of magnetic materials) – Weiss theory of ferromagnetism-soft ferrites and hard ferrites- Hysteresis – Soft and Hard magnetic materials- Applications magnetic materials.

UNIT-IV

Quantum Mechanics and Free Electron Theory

Quantum Mechanics: Dual nature of matter – Schrodinger's time independent and dependent wave equation – Significance of wave function – Particle in a one-dimensional infinite potential well.

Free Electron Theory: Classical free electron theory (Merits and demerits only) – Quantum free electron theory – Equation for electrical conductivity based on quantum free electron theory – Fermi-Dirac distribution – Density of states – Fermi energy.

UNIT-V

Semiconductors and Superconductors

Semiconductors- Introduction – Intrinsic semiconductors – Electrical conductivity – Fermi level – Extrinsic semiconductors –Dependence of Fermi energy on carrier concentration and temperature – Drift and diffusion currents – Einstein's equation – Direct and indirect band gap semiconductors – Hall effect – Hall coefficient – Applications of Hall effect.

Superconductors- Introduction – Properties of superconductors – Meissner effect – Type I and Type II superconductors – BCS theory – Josephson effects (AC and DC) –High T_c superconductors – Applications of superconductors.

Text books:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company
2. Engineering Physics – B.K. Pandey and S. Chaturvedi, Cengage Learning.

Reference Books:

1. Engineering Physics – Shatendra Sharma, Jyotsna Sharma, Pearson Education, 2018
2. Engineering Physics – K. Thyagarajan, McGraw Hill Publishers
3. Engineering Physics - Sanjay D. Jain, D. Sahasrambudhe and Girish, University Press
4. Semiconductor physics and devices- Basic principle – Donald A, Neamen, McGraw Hill

<table>
<tr><td>Course Title</td><td colspan="5">Communicative English</td><td colspan="3">B.Tech EEE I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2024103</td><td rowspan="2">Humanity & Social Sciences Course (HSMC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn, listening skills for better comprehension, improve speaking skills through participation in activities such as role plays, discussions and structured talks/oral presentations, Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information, knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply grammatical structures to formulate sentences and correct word forms</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze discourse markers to speak clearly on a specific topic in informal discussions</td></tr>
<tr><td>CO 4</td><td colspan="8">Evaluate reading/listening texts and to write summaries based on global comprehension of these texts.</td></tr>
<tr><td>CO 5</td><td colspan="8">Create a coherent paragraph interpreting a figure/graph/chart/table</td></tr>
</table>

UNIT-I

Lesson: On the Conduct of Life: William Hazlitt

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.

Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.

Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.

Writing: Beginnings and endings of paragraphs - introducing the topic, summarizing the main idea and/or providing a transition to the next paragraph.

Grammar and Vocabulary: Parts of Speech; Word formation, synonyms and antonyms; Idioms and Phrases; phrasal verbs.

UNIT- II

Lesson: The Brook: Alfred Tennyson

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.

Speaking: Discussion in pairs/small groups on specific topics followed by short structured talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Paragraph writing (specific topics) using suitable cohesive devices; mechanics of writing - punctuation, capital letters.

Grammar and Vocabulary: Sentence structure; articles; Tenses; Prepositions.

UNIT-III

Lesson: A City Night Piece - Oliver Goldsmith

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Paragraph Writing Grammar and Vocabulary: Voice; Reported Speech; Degrees of Comparison, Subject with agreement.

UNIT- IV

Lesson: Being Rich, Being Good - Chetan Bhagat

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters/Report Writing

Grammar and Vocabulary: Information Transfer; Simple, Compound and Complex sentences; Question Tags.

UNIT-V

Lesson: Politics and the English Language: George Orwell

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts - without the use of PPT slides.

Reading: Reading for comprehension.

Writing: Writing structured essays on specific topics using suitable claims and evidence.

Grammar and Vocabulary: Reading Comprehension; Dialogue Writing; Common Errors.

Text Books:

1. Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Raymond Murphy's English Grammar in Use Fourth Edition (2012) E-book.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. Oxford Learners Dictionary, 12th Edition, 2011.
6. Norman Lewis Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary (2014)
7. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Words by David Butler.

Web links:

www.englishclub.com

www.easyworldofenglish.com

www.languageguide.org/english/

www.bbc.co.uk/learningenglish

www.eslpod.com/index.html

www.myenglishpages.com

<table>
<tr><td>Course Title</td><td colspan="5">C-Programming & Data Structures</td><td colspan="3">B.Tech EEE I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2005103</td><td rowspan="2">Engineering Science Course
(ESC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn problem-solving through programming, the basic concepts of the C programming language and gain knowledge on data structures and their applications.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Formulate simple algorithms for arithmetic and logical problems and to translate the algorithms to programs (in C Language).</td></tr>
<tr><td>CO 2</td><td colspan="8">Choose the loops and decision-making statements to solve the problem</td></tr>
<tr><td>CO 3</td><td colspan="8">Implement different Operations on arrays</td></tr>
<tr><td>CO 4</td><td colspan="8">Use functions to solve the given problem</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand structures, unions and pointers</td></tr>
<tr><td>CO 6</td><td colspan="8">Understand need of data structures in real time situations</td></tr>
</table>

<u>UNIT- I</u>

Introduction to C programming: C language elements, variable declarations and data types, operators and expressions, decision statements - If and switch statements, loop control statements - while, for, do-while statements.Jumping statements: break, continue and goto statements

<u>UNIT-II</u>

Arrays: Introduction, Declaration and initialization of 1D and 2D arrays, Functions:Introduction, Category of functions, parameter passing methods, Storage Classes, Recursive functions.Strings:String I/O functions, string handling functions, array of strings

<u>UNIT- III</u>

Pointers: Introduction to pointers, declaring and initialization of pointer variables, accessing the address of variables, accessing a variable through its pointer, chain of pointers. Structures and unions: Introduction, defining a structure, declaring structure variable, structure initialization, accessing members of structure, copying and comparing structure variables, structures within structures, array of structures, and introduction of union.

UNIT- IV

Data Structures: Overview on data structures, stack, basic operations on stack, Applications of stacks; Queues -various classification of queues, basic operations on queues. Searching and sorting: linear search, binary search, bubble sort, selection sort, insertion sort.

UNIT-V

Linked Lists – Single linked list, Operations on Single Linked List: insertion, deletion and searching operations, doubly linked lists and its operations, circular linked lists and its operations. Trees - Tree terminology, representation, Binary trees, representation, binary tree traversals. Binary tree operations.

Text Books:

1. E. Balagurusamy, C Programming and Data structures,Fourth Edition, McGrawHill.
2. Rema Theraja, Programming in C, second edition,Oxford.
3. Fundamentals of Data Structures in C, Ellis Horowitz, SartajSahni, Susan Anderson-Freed, Computer Science Press.
4. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. AnandaRao, Pearson Education

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India
2. R.G. Dromey, How to solve it by Computer,Pearson.
3. YashavantKanetkar, Let us C, 15th edition, BPBPublications.
4. Dr. P. ChennaReddy, Computer Fundamentals and C Programming, Second Edition.

Course Title	Engineering Drawing					B.Tech EEE I Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003105	**Engineering Science Course (ESC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		1	**0**	**2**	**2**	**40**	**60**	**100**
Mid Exam Duration : 2Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to practice for accuracy and clarity in presenting the technical information, develop the engineering imagination essential for successful design and awareness on Engineering Drawing.								
Course Outcomes: On successful completion of this course, the students will be able to,								
CO 1	Draw various curves applied in engineering							
CO 2	Show projections of solids and sections graphically							
CO 3	Draw the development of surfaces of solids							
CO 4	Draw orthographic and isometric projections							
CO 5	Evaluate different methods of perspective view							

UNIT- I

Introduction to Engineering Drawing: Principles of Engineering Drawing and its Significance-Conventions in drawing-lettering - BIS conventions.

A. Conic sections including the rectangular hyperbola- general method only,
B. Cycloid, epicycloids and hypocycloids
C. Involutes

UNIT- II

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.

Projections of solids: Projections of regular solids inclined to one or both planes by rotational or auxiliary view method.

UNIT-III

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

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

UNIT- IV

Orthographic Projections: Systems of projections, conventions and application to orthographic projections - simple objects.

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

UNIT-V

Perspective projection – applications of perspective view –terminology of perspective view- methods of drawing perspective view-simple problems.

Text Books:

1. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
2. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers,2016.

Reference Books

1. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, CopyRight,2009
2. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers,2000
3. Shah and Rana, Engineering Drawing, 2/e, Pearson Education,2009
4. K.C.John, Engineering Graphics, 2/e, PHI,2013
5. Basant Agarwal & C.M.Agrawal, Engineering Drawing, Tata McGraw-Hill, CopyRight, 2008.

Additional Sources:

Youtube: http-sewor, Carleton. cag,kardos/88403/drawings.html conic sections-online, red woods.edu

<table>
<tr><td>Course Title</td><td colspan="4">Engineering Drawing Lab</td><td colspan="4">B.Tech EEE I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2003106</td><td rowspan="2">Engineering Science Course (ESC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>2</td><td>1</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to practice for accuracy and clarity in presenting the technical information, develop the engineering imagination essential for successful design and awareness on Engineering Drawing.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Make Use of computers as a drafting tool</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply isometric drawings using CAD packages</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze orthographic drawings using CAD packages</td></tr>
</table>

- ❖ Instruct the utility of drafting & modeling packages in orthographic and isometric drawings.
- ❖ Train the usage of 2D and 3D Modeling.
- ❖ Instruct graphical representation of machine components.

Computer Aided Drafting

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.

Dimensioning principles and conventional representations.

Orthographic Projections: Systems of projections, conventions and application to orthographic projections - simple objects.

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

Text Books:

1. K. Venugopal, V.Prabhu Raja, Engineering Drawing + AutoCad, New Age International Publishers.
2. Kulkarni D.M, AP Rastogi and AK Sarkar, Engineering Graphics with AutoCad, PHI Learning, Eastern Economy editions.

Reference Books:

1. T. Jeyapoovan, Engineering Graphics using AutoCad, Vikas Publishing House
2. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, Scitech Publishers, Chennai, 2012.
3. Linkan Sagar, BPB Publications, AutoCad 2018 Training Guide.
4. K.C.John, Engineering Graphics, 2/e, PHI,2013
5. Basant Agarwal & C.M.Agrawal, Engineering Drawing, Tata McGraw-Hill, CopyRight, 2008.

Additional Sources

Youtube: http-sewor,Carleton.cag, kardos/88403/drawings.html conic sections-online, red woods.edu

<table>
<tr><td>Course Title</td><td colspan="5">Applied Physics Lab</td><td colspan="3">B.Tech EEE I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20AP107</td><td rowspan="2">Basic Sciences Course (BSC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: This course The objective of the course is to learn, understand the concepts of interference, diffraction and their applications, the role of optical fiber parameters in communication, Recognize the importance of energy gaps in the study of conductivity and the Hall Effect in a semiconductor., Illustrates the magnetic and dielectric materials applications and apply the principles of semiconductors in various electronic devices.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Operate various optical instrument</td></tr>
<tr><td>CO 2</td><td colspan="8">Estimate wavelength of laser and particles size using laser, the susceptibility and related magnetic parameters of magnetic materials</td></tr>
<tr><td>CO 3</td><td colspan="8">Evaluate the acceptance angle of an optical fiber and numerical aperture</td></tr>
<tr><td>CO 4</td><td colspan="8">Plot the intensity of the magnetic field of circular coil carrying current with distance</td></tr>
<tr><td>CO 5</td><td colspan="8">Determine magnetic susceptibility of the material and its losses by B-H curve</td></tr>
<tr><td>CO 6</td><td colspan="8">Apply the concepts of ultrasonics by acoustic grating</td></tr>
</table>

List of Experiments: (Any Eight)

1. Determine the thickness of the wire using wedge shape method
2. Determination of the radius of curvature of the lens by Newton's ring method
3. Determination of wavelength by plane diffraction grating method
4. Determination of dispersive power of prism.
5. Determination of wavelength of LASER light using diffraction grating.
6. Determination of particle size using LASER.
7. To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle
8. Determination of dielectric constant by charging and discharging method.
9. Magnetic field along the axis of a circular coil carrying current –Stewart Gee's method.

10. Study the variation of B versus H by magnetizing the magnetic material (B-H curve)

11. To determine the resistivity of semiconductor by Four probe method

12. To determine the energy gap of a semiconductor

Reference Books:

1. S. Balasubramanian, M.N. Srinivasan "A Text book of Practical Physics"- S Chand, Publishers, 2017.

2. http://vlab.amrita.edu/index.php -Virtual Labs, Amrita University.

<table>
<tr><td>Course Title</td><td colspan="4">Communicative English Lab</td><td colspan="3">B.Tech EEE I Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2024108</td><td rowspan="2">Humanity & Social Science Course (HSC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:The objective of the course is to learn a variety of self instructional, friendly modes of language learn, better pronunciation through stress, intonation and rhythm, effective language to face interviews, group discussions, public speaking and will be initiated into greater use of the computer in resume preparation, report writing, format making etc.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Listening and repeating the sounds of English Language.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand the different aspects of the English language, proficiency with emphasis on LSRW skills.</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply communication skills through various language learning activities</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze the English speech sounds, stress, rhythm, intonation and syllable, division for better listening and speaking comprehension.</td></tr>
<tr><td>CO 5</td><td colspan="8">Evaluate and exhibit acceptable etiquette essential in social and professional settings.</td></tr>
<tr><td>CO 6</td><td colspan="8">Create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.</td></tr>
</table>

The following skills that will be learnt in the lab are

1. Listening Skills, Phonetics, Introducing oneself
2. Describing objects, JAM / Interpretation of Hypothetical Situations,

Role play

3. Hypothetical situations (If…….. were), Elocution, TED talks videos
4. Visual Description, Situational conversations
5. Oral Presentations, PowerPoint presentations

Suggested Software

1. Orell
2. Walden Infotech
3. Young India Films

4. K-Van solutions

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational.
4. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.
5. A Textbook of English Phonetics for Indian Students by T.Balasubramanyam

Web Links

www.esl-lab.com, www.englishmedialab.com, www.englishinteractive.net

Course Title	C-Programming & Data Structures Lab					B.Tech EEE I Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2005108	**Engineering Science Course (ESC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**3**	**1.5**	**40**	**60**	**100**
						End Exam Duration : 3Hrs		

Course Objectives: The objective of the course is to learn. how to write and debug programs, the principles of designing structured programs, Write basic C programs using, Selection statements, Repetitive statements, Functions, Pointers, Arrays, Strings and Structures and apply suitable data structure to solve real world problems.

Course Outcomes: On successful completion of this course, the students will be able to,

CO 1	Formulate the algorithms for simple problems
CO 2	Translate given algorithms to a working and correct program
CO 3	Correct syntax errors as reported by the compilers
CO 4	Identify and correct logical errors encountered at runtime
CO 5	Write iterative as well as recursive programs, programs on data structures like stack, queue, linked list, trees etc
CO 6	Represent data in arrays, strings and structures and manipulate them through a program.

<u>List of Experiments</u>

1. Ramesh ‘s basic salary is input through the keyboard. His dearness allowance is 40% of basic salary and house rent allowance is 20% of basic salary. Write a C program to calculate his gross salary.
2. Write a program to take input of name, roll no and marks obtained by a student in 5 subjects each have its 100 full marks and display the name, roll no with percentage score secured.
3. a) Write a C program to find out whether a given number is even number or odd number

   b) Write a C program to check whether a given year is leap year or not.
4. Design and develop an algorithm that takes three coefficients (a, b, and c) of a Quadratic equation ($ax^2+bx+c=0$) as input and compute all possible

roots. Implement a C program for the developed algorithm and execute the same to output the possible roots for a given set of coefficients with appropriate messages.

5. If the ages of Ramesh, Suresh and Mahesh are input through the keyboard, write a C program to determine the youngest of the three.

6. A character is entered through a keyboard. Write a C program to determine whether the character entered is a capital letter, a small case letter, a digit or a special symbol using if- else and switch case. The following table shows the range of ASCII values for various characters.

Characters	**ASCII values**
A–Z	65 – 90
a– z	97 – 122
0 – 9	48 – 57
Special Symbols	0 – 47, 58 – 64, 91 – 96, 123 – 127.

7. Write a C program which takes two integer operands and one operator from the user, performs the operation and then prints the result. (Consider the operators +, -, *, /, % and use switch statement).

8. Design and develop an algorithm to find whether a given number is Armstrong number or not. Implement a C program for the developed algorithm.

9. Design and develop an algorithm to check whether a given number is palindrome or not. Implement a C program for the same.

10. Write a C program to generate all the prime numbers between 1 and n, where n is a value supplied by the user.

11. Write a C program to generate the first N terms of Fibonacci sequence.

12. Write a C program to find the smallest and largest number in a given array.

13. Write a C program to find the frequency of a particular number in a list of integers.

14. Write a C program to sort the list of elementsusing

    a) BubbleSort b) Selection Sort.

15. Write a C program to search for an element in a list of elements using

    a) Linear search b) Binary search

16. Write a C program to read two matrices and perform the following operations

    a) Addition of two matrices

    b) Multiplication of two matrices

17. **Partitioning an array**

    Given a randomly ordered array of n elements, write a C program to partition the elements into two subsets such that elements $\leq$X are in one subset and elements $\geq$X are in another subset.

18. Write a C program to rearrange the elements in an array so that they appear in reverse order.

19. If a string and its reversed string are the same then the string is called a palindrome string. Design and develop an algorithm to check whether a given string is a palindrome or not and implement a C program for the same.

20. Write a C program to read two strings and perform the following operations without using built string library functions.

    i) String length ii) String reversing

    iii) Comparison of two strings iv) Concatenation of two strings

21. Write a C program to count the number of vowels, consonants, digits, blank spaces and special characters in a given string.

22. Write a C program to swap the contents of two variables using

    a) Call by value

    b) Call by reference.

23. Write a C program using recursion

    a) Find the factorial of a given number

    b) Print the Fibonacci series up to a given number.

    c) Find the GCD of two integers.

24. Write a C program to define a structure with the following members.

    Roll No., Name, marks in Sub1, Sub2, Sub3. Read the n students records and find the total marks of each student and print the result in the following format.

Roll Number	**Name**	**Sub 1**	**Sub 2**	**Sub 3**	**Total Marks**	**Result**
239Y1A0501	Siva	80	70	75	225	Distinction

25. Write C programs that implement stack (its operations) using
    i) Arrays
    ii) Pointers
26. Write C programs that implement Queue (its operations) using
    i) Arrays
    ii) Pointers
27. Write a C program that uses Stack operations to perform the following:
    i) Converting infix expression into postfix expression
    ii) Evaluating the postfix expression.
28. Write a C program that uses functions to perform the following operations on a single linked list.
    i) Creation ii) Insertion
    iii)Deletion iv) Traversal
29. Write a C program that uses functions to perform the following operations on a Doubly linked list.
    i) Creation ii) Insertion iii) Deletion iv) Traversal
30. Write a C program that uses functions to perform the following:
    i) Creating a Binary Tree of integers
    ii) Traversing the above binary tree in preorder, inorder and postorder.

Text Books:

1. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. Ananda Rao, Pearson Education.
2. B.A.Forouzan and R.F. Gilberg, "COMPUTER SCIENCE: A Structured Programming Approach Using C", Third edition, CENGAGE Learning, 2016.
3. Richard F. Gilberg& Behrouz A. Forouzan, "Data Structures: A Pseudocode Approach with C", Second Edition, CENGAGE Learning, 2011
4. E. Balagurusamy, Programming in ANSI C, Fifth Edition, McGrawHill.

B.Tech II SEM EEE (R20)

<table>
<tr><td>Course Title</td><td colspan="5">Differential Equations & Vector Calculus</td><td colspan="3">B.Tech EEE II Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2021201</td><td rowspan="2">Basic Science Course (BSC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the concepts of differentiation and integration. The students will be applying these fundamentals to their engineering applications.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand vector differentiation concepts</td></tr>
<tr><td>CO 2</td><td colspan="8">Classify second and higher order linear differential equations with constant coefficients.</td></tr>
<tr><td>CO 3</td><td colspan="8">Solve partial differential equations</td></tr>
<tr><td>CO 4</td><td colspan="8">Apply vector integration concepts</td></tr>
<tr><td>CO 5</td><td colspan="8">Analyze the applications of partial differential equations.</td></tr>
</table>

UNIT- I

Linear differential equations of higher order (constant coefficients) : Definitions, homogeneous and non- homogeneous, complementary function, general solution, particular integral, Wronskian, Method of variation of parameters.

UNIT-II

Partial Differential Equations: Introduction and formation of Partial Differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order equations using Lagrange's method.

UNIT-III

Applications of Partial Differential Equations: Classification of PDE, method of separation of variables for second order equations. Applications of Partial Differential Equations: One dimensional Wave equation.

UNIT-IV

Vector differentiation: Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT-V

Vector integration: Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-43 edition 2014.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 9th edition- 2013.
3. Calculus and Analytic geometry, G.B. Thomas and R.L. Finney, Pearson, 9th Edition, Reprint, 2002.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, Mc. Graw Hill Education (India) Pvt. Ltd, New Delhi, 11th Edition, Reprint 2010.
2. A TextBook of Engineering Mathematics, N.P. Bali and Manish Goyal, Lakshmi Publications, Reprint 2008.
3. Differential Equations and Vector Calculus, Dr. B.Rama Bhupal Reddy, G.Sreedhar, Dr. V.Ramachandra Reddy, Research India Publications, Delhi, 2020.

<table>
<tr><td>Course Title</td><td colspan="4">Chemistry</td><td colspan="3">B.Tech II SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2023202</td><td rowspan="2">Basic Science Course (BSC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn
• To familiarize engineering chemistry and its applications
• To train the students on the principles and applications of electrochemistry and polymers.
• To introduce instrumental methods, molecular machines and switches.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Compare the materials of construction for battery and electrochemical sensors.</td></tr>
<tr><td>CO 2</td><td colspan="8">Explain the preparation, properties, and applications of thermoplastics & thermosetting, elastomers & conducting polymers.</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand the principles of spectrometry, slc in separation of solid and liquid mixtures.</td></tr>
<tr><td>CO 4</td><td colspan="8">Remember the principle of Band diagrams in application of conductors and semiconductors.</td></tr>
<tr><td>CO 5</td><td colspan="8">Analyze the principles and different applications of analytical instruments.</td></tr>
</table>

UNIT-I

Structure and Bonding Models: Planck's quantum theory, dual nature of matter, Schrodinger equation, significance of Ψ and Ψ^2, applications to hydrogen, molecular orbital theory – bonding in homo- and heteronuclear diatomic molecules – energy level diagrams of O2 , NO and CO, etc., calculation of bond order.

UNIT-II

Modern Engineering Materials: i). Understanding of materials: Crystal field theory – salient features – splitting in octahedral, tetrahedral and square planar geometry. Properties of coordination compounds-Oxidation state, coordination, magnetic properties and color.

ii). Semiconductor materials, superconductors- basic concept, band diagrams for conductors, semiconductors and insulators, Effect of doping on band structures.

iii). Nanochemistry: Introduction, classification of nanomaterials, properties and applications of Fullerenes, carbon tubes and Graphines nanoparticles.

UNIT-III

Electrochemistry and Applications: Introduction to Electrodes – concepts, reference electrodes (Calomel electrode, Ag/AgCl electrode and glass electrode); Electrochemical cell, Nernst equation, cell potential calculations and numerical problems, Potentiometry- Potentiometric titrations (redox titrations), concept of conductivity, conductivity cell, conductometric titrations (acid-base titrations), pH metric concepts.

Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion batteries- working of the batteries including cell reactions; Fuel cells, hydrogen-oxygen, methanol fuel cells – working of the cells.

UNIT-IV

Polymer Chemistry: Introduction to polymers, functionality of monomers, chain growth and step growth polymerization, coordination polymerization, copolymerization (stereospecific polymerization) with specific examples and mechanisms of polymer formation.

Plastics - Thermoplastics and Thermosettings, Preparation, properties and applications of – PVC, Teflon, Bakelite, Nylon-6,6.

Elastomers–Buna-S, Buna-N–preparation, properties and applications.

Conducting polymers – polyacetylenes,– mechanism of conduction and applications.

UNIT-V

Instrumental Methods and Applications: Electromagnetic spectrum. Absorption of radiation: Beer-Lambert’s law. Regions of Electromagnetic radiation. UV-Visible, IR Spectroscopy'- (selection rules, principles and applications). Solid-Liquid Chromatography–TLC, retardation factor.

Text Books:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins’ Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. G.V.Subba Reddy, K.N.Jayaveera and C. Ramachandraiah, Engineering Chemistry, McGraw Hill, 2020.
2. D. Lee, Concise Inorganic Chemistry, 5/e, Oxford University Press, 2008.
3. Skoog and West, Principles of Instrumental Analysis, 6/e, Thomson, 2007.
4. J.M.Lehn, SupraMolecular Chemistry, VCH Publications.

Course Title	Electrical Circuit Analysis - I					B.Tech II SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002203	**Engineering Science Course (ESC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration : 2Hrs						**End Exam Duration : 3Hrs**		

Course Objectives: The objective of the course is to learn the basic concepts of DC and AC circuits, Network Theorems , Three phase circuits, Magnetic Circuits & Graph Theory.

Course Outcomes: On successful completion of this course, the students will be able to,

CO 1	Understand the basic fundamentals of DC & AC circuits, network reduction techniques, magnetic circuits, graph theory, dual & duality networks.
CO 2	Determine the currents, voltages using mesh and nodal analysis, Average and RMS values for different waveforms.
CO 3	Obtain self and mutual inductances for magnetic circuits, incidence matrix, cutset and tie set matrices for planar networks
CO 4	Evaluate the active and reactive powers, voltage and currents for balanced and unbalanced networks.
CO 5	Solve DC & AC circuits by using various network theorems.

UNIT-I

Electrical Circuits: Circuit Concept – Types of elements - Source Transformation-Voltage - Current Relationship for Passive Elements. Kirchhoff's Laws – Network Reduction Techniques- Series, Parallel, Series Parallel, Star-to-Delta or Delta-to-Star Transformation.

Magnetic Circuits: Faraday's Laws of Electromagnetic Induction-Concept of Self and Mutual Inductance-Dot Convention-Coefficient of Coupling-Composite Magnetic Circuits -Analysis of Series and Parallel Magnetic Circuits.

UNIT-II

Single Phase A.C Circuits: Sinusoidal Alternating Quantities - Average Value, R.M.S, Form Factor and Peak Factor for Different Periodic Waveforms – Phasor Representation of alternating quantities– Complex and Polar Form of Representation, j-Notation, Steady State Analysis of R, L and C (In Series, Parallel and Series Parallel Combinations) with Sinusoidal Excitation- Phasor diagrams - Concept of Reactance, Impedance, Susceptance and Admittance- Apparent Power, Active and Reactive Power - Concept of Power Factor.

UNIT-III

Network Theorems: Superposition Theorem - Reciprocity Theorem - Thevenin's Theorem - Norton's Theorem - Maximum Power Transfer Theorem - Millmann's Theorem - Tellegen's Theorem - Compensation Theorem (All theorems for both D.C and A.C Excitation).

UNIT-IV

Three Phase A.C. Circuits: Introduction - Analysis of Balanced and Unbalanced Three Phase Circuits – Phase Sequence- Star and Delta Connection - Relation between Line and Phase Voltages and Currents in Balanced Systems – Representation and Measurement of Active and Reactive Power in Balanced and Unbalanced Three Phase Systems - Advantages of Three Phase System.

UNIT-V

Network Topology: Definitions – Graph – Oriented Graph-Tree, Cutset, Tieset, Basic Cutset, Basic Tie Set Matrices for Networks – Loop and Nodal Analysis of Networks with Independent and Dependent Voltage and Current Sources – Incidence Matrices - Duality & Dual Networks.

Text Books:

1. Fundamentals of Electric Circuits Charles K. Alexander and Matthew. N. O. Sadiku, McGraw Hill, 5th Edition, 2013.
2. Engineering circuit analysis William Hayt and Jack E. Kemmerly, McGraw Hill Company, 7th Edition, 2006.

Reference Books:

1. Circuit Theory Analysis & Synthesis A. Chakrabarti, Dhanpat Rai & Sons, 7th Revised Edition, 2018.
2. Network Analysis M.E Van Valkenburg, Prentice Hall (India), 3rd Edition, 1999.
3. Electrical Engineering Fundamentals V. Del Toro, Prentice Hall International, 2nd Edition, 2019.
4. Electric Circuits- Schaum's Series, McGraw Hill, 5th Edition, 2010.
5. Fundamentals of Electrical Engineering NPTEL Lectures by Prof. Debapriya Das, IIT Kharagpur.

<table>
<tr><td>Course Title</td><td colspan="5">Electronic Devices & Circuits</td><td colspan="3">B.Tech II SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2004204</td><td rowspan="2">Engineering Science Course (ESC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the basic principles of all semiconductor devices, to diode circuits, and amplifier circuits, biasing and small signal equivalent circuits of amplifiers, compare the performance of BJTs and MOSFETs and design rectifier circuits and various amplifier circuits using BJTs and MOSFETs.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the principle of operation, characteristics and applications of Semiconductor diodes, Bipolar Junction Transistor and MOSFETs.</td></tr>
<tr><td>CO 2</td><td colspan="8">Applying the basic principles solving the problems related to Semiconductor diodes, BJTs, and MOSFETs.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze diode circuits for different applications such as rectifiers, clippers and clampers also analyze biasing circuits of BJTs, and MOSFETs</td></tr>
<tr><td>CO 4</td><td colspan="8">Design of diode circuits and amplifiers using BJTs, and MOSFETs.</td></tr>
<tr><td>CO 5</td><td colspan="8">Compare the performance of various semiconductor devices.</td></tr>
</table>

UNIT-I

Review of Semiconductors: Intrinsic semiconductors, Doped Semiconductors, Current Flow in Semiconductors, PN Junction with Open Circuit, PN Junction with Applied Voltage, Capacitive Effects in PN Junction.

Diodes: Introduction, The Ideal Diode – current voltage characteristic, rectifier, diode logic gates, Terminal Characteristics of Junction Diodes– forward bias, reverse bias, and breakdown regions, Modeling the Diode Forward Characteristics-exponential model, graphical analysis and Iterative analysis using the exponential model, constant voltage drop model, the small signal model.

UNIT-II

Zener Diodes: Zener diode Characteristics, Voltage shunt regulator, Temperature Effects, Rectifier Circuits– half-wave, full-wave and bridge rectifier circuits, rectifier with a filter capacitor, C-L-C filter, Clipping and Clamping Circuits–

limiter circuit, the clamped capacitor, voltage doubler, Special Diode Types– UJT, Schottky barrier diode, Varactor diode, photo diode, light emitting diode(LED), Problem Solving.

Bipolar Junction Transistors(BJTs): Physical Operation - simplified structure and modes of operation, Operation of the npn, and pnp transistors: cutoff, active, and saturation modes, V-I Characteristics- of different configurations - graphical representation of transistor characteristics, dependence of collector current on collector voltage, the Early Effect.

UNIT-III

BJT circuits at DC, Applying the BJT in Amplifier Design - Voltage Amplifier, Voltage Transfer Characteristic (VTC), Small-Signal Voltage Gain, determining the VTC by Graphical Analysis, Q-point, Small-signal operation and models- the transconductance, input resistance at the base, input resistance at the emitter, Voltage gain, separating the Signal and the DC Quantities, The Hybrid-π Model, the T Model, Basic BJT Amplifier Configurations - Common-Emitter (CE) amplifier without and with emitter resistance, Common-Base (CB) amplifier, Common-Collector (CC) amplifier or Emitter Follower, Biasing in BJT Amplifier Circuits- Fixed bias, Self bias, voltage divider bias circuits, biasing using a Constant-Current Source, CE amplifier – Small signal analysis and design, Transistor breakdown and Temperature Effects, Problem solving.

UNIT-IV

MOS Field-Effect Transistors (MOSFETs): Introduction, Device Structure and Physical Operation – device structure, operation with zero gate voltage, creating a channel for current flow, operation for different drain to source voltages, the P-channel MOSFET,CMOS, V-I characteristics–i_D - v_{DS} characteristics, i_D – v_{GS} characteristics, finite output resistance in saturation, characteristics of the p-Channel MOSFET, MOSFET Circuits at DC, Applying the MOSFET in Amplifier Design – voltage transfer characteristics, biasing the MOSFET to obtain linear amplification, the small signal voltage gain, graphical analysis, the Q-point. Problem solving.

UNIT-V

MOSFET Small Signal Operation Models – the dc bias, separating the DC analysis and the signal analysis, Small signal equivalent circuit models, the transconductance, the T equivalent circuit model, Basic MOSFET Amplifier

Configurations – three basic configurations, characterizing amplifiers, common source(CS) amplifier without and with source resistance, common gate (CG) amplifier, source follower, the amplifier frequency response, Biasing in MOSFET Amplifier Circuits– biasing by fixing V_{GS} with and without source resistance, biasing using drain to gate feedback resistor, biasing using constant current source, Common Source Amplifier using MOSFETs – Small signal analysis and design, Body Effect, Problem Solving.

Text Books:

1. Adel S. Sedra and KennethC. Smith, "Microelectronic Circuits – Theory and Applications", 6th Edition, Oxford Press, 2013.
2. Donald A Neamen, "Electronic Circuits – analysis and design", 3rd Edition, McGraw Hill (India), 2019.

Reference Books:

1. J. Milliman and C Halkias, "Integrated electronics", 2nd Edition, Tata McGraw Hill, 1991.
2. Behzad Razavi, "Microelectronics", Second edition, Wiley, 2013.
3. R.L. Boylestad and Louis Nashelsky, "Electronic Devices and Circuits," 9th Edition, Pearson, 2006.
4. Jimmie J Cathey, "Electronic Devices and Circuits," Schaum's outlines series, 3rd edition, McGraw-Hill (India), 2010.

Course Title	Engineering Workshop					B. Tech. II Semester (EEE)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20EW205	Engineering Science Course (ESC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		0	0-	3	1.5	40	60	100
						End Exam Duration : 3Hrs		

Course Objectives: The objective of the course is to learn sheet metal operations, fitting, electrical house wiring skills and wood working.

Course Outcomes: On successful completion of this course, the students will be able to,

CO 1	Apply wood working skills in real world applications
CO 2	Build different objects with metal sheets in real world applications
CO 3	Apply fitting operations in various applications.
CO 4	Apply different types of basic electric circuit connections
CO 5	Use soldering and brazing techniques

Wood Working

Familiarity with different types of woods and tools used in wood working and making following joints.

- ❖ Half – Lap Joint
- ❖ Mortise and Tenon Joint
- ❖ Corner Dovetail joint or Bridle Joint

Sheet Metal Working

Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets

A. Taperedtray
B. Conical Funnel
C. Elbow Pipe
D. Brazing

Fitting

Familiarity with different types of tools used in fitting and do the following fitting exercises

A. V-fit

B. Dovetail Fit

C. Semi-circular fit

D. square fitting

Electrical Wiring

Familiarities with different types of basic electrical circuits and make the following connections

A. Parallel And Series

B. Two Way Switch

C. Godown Lighting

D. Tubelight

E. Three Phase Motor

F. Soldering of wires

Note: In each section a minimum of three exercises are to be carried out.

<table>
<tr><td>Course Title</td><td colspan="5">IT Workshop</td><td colspan="3">B.Tech II SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2005206</td><td rowspan="2">Engineering Science Course
(ESC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn about the internal parts of a computer, assembling and disassembling a computer from the parts, preparing a computer for use by installing the operating system, Technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations and LATEX and Networking of computers and use Internet facility for Browsing and Searching.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Disassemble and Assemble a Personal Computer and prepare the computer ready to use.</td></tr>
<tr><td>CO 2</td><td colspan="8">Prepare the Documents using Word processors and Prepare spreadsheets for calculations using excel and also the documents using LATEX</td></tr>
<tr><td>CO 3</td><td colspan="8">Prepare Slide presentations using the presentation tool</td></tr>
<tr><td>CO 4</td><td colspan="8">Interconnect two or more computers for information sharing</td></tr>
<tr><td>CO 5</td><td colspan="8">Access the Internet and Browse it to obtain the required information</td></tr>
</table>

Preparing your Computer

Task 1:

Learn about Computer: Identify the internal parts of a computer, and its peripherals. Represent the same in the form of diagrams including the Block diagram of a computer. Write specifications for each part of a computer including peripherals and specification of Desktop computer. Submit it in the form of a report.

Task 2:

Assembling a Computer: Disassemble and assemble the PC back to working condition. Students should be able to troubleshoot the computer and identify working and non-working parts. Students should identify the problem correctly by various methods.

Task 3:

Install Operating system: Students should install Linux on the computer. Students may install another operating system (including proprietary software) and make the system dual boot or multi boot.Students should record the entire installation process.

Task 4:

Operating system features: Students should record the various features that are supported by the operating system(s) installed. They have to submit a report on it. Students should be able to access CD/DVD drives, write CD/DVDs, access pen drives, print files, etc. Students should install new application software and record the installation process.

Networking and Internet

Task 5:

Networking: Students should connect two computers directly using a cable or wireless connectivity and share information. Students should connect two or more computers using a switch/hub and share information. Crumpling activity, logical configuration etc. should be done by the student. The entire process has to be documented.

Task 6:

Browsing Internet: Students should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create an email account and send email.

They should get acquainted with applications like Facebook, skype etc. If an Intranet mailing facility is available in the organization, then students should share the information using it. If the operating system supports sending messages to multiple users (LINUX supports it) in the same network, then it should be done by the student. Students are expected to submit the information about different browsers available, their features, and search process using different natural languages, and creating email accounts.

Task 7:

Antivirus: Students should download freely available Antivirus software, install it and use it to check for threats to the computer being used. Students should submit information about the features of the antivirus used, installation process, about virus definitions, virus engine etc.

Productivity tools

Task 8:

Word Processor: Students should be able to create documents using the word processor tool. Some of the tasks that are to be performed are inserting and deleting the characters, words and lines, Alignment of the lines, Inserting header and Footer, changing the font, changing the color, including images and tables in the word file, making page setup, copy and paste block of text, images, tables, linking the images which are present in other directory, formatting paragraphs, spell checking, etc. Students should be able to prepare project cover pages, content sheets and chapter pages at the end of the task using the features studied. Students should submit a user manual of the word processor considered, Image Manipulation tools.

Task 9:

Presentations: creating, opening, saving and running the presentations, selecting the style for slides, formatting the slides with different fonts, colors, creating charts and tables, inserting and deleting text, graphics and animations, bulleting and numbering, hyperlinking, running the slide show, setting the timing for slide show.

Task 10:

Spreadsheet: Students should be able to create, open, save the application documents and format them as per the requirement. Some of the tasks that may be practiced are Managing the worksheet environment, creating cell data, inserting and deleting cell data, format cells, adjusting the cell size, applying formulas and functions, preparing charts, sorting cells. Students should submit a user manual of the Spreadsheet.

Task 11:

LateX: Introduction to Latex and its installation and different IDEs. Creating the first document using Latex, using content into sections using article and book class of LaTeX. Styling Pages: reviewing and customizing different paper sizes and formats. Formatting text (styles, size, alignment, colors and adding bullets and numbered items, inserting mathematical symbols, and images, etc.). Creating basic tables, adding simple and dashed borders, merging rows and columns. Referencing and Indexing: cross-referencing (refer to sections, table, images), bibliography (references).

<u>Reference Books:</u>

1. Introduction to Computers, Peter Norton, McGraw Hill
2. MOS study guide for word, Excel, PowerPoint & Outlook Exams, Joan Lambert, Joyce Cox, PHI.
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education.
4. Networking your computers and devices, Rusen, PHI
5. Troubleshooting, Maintaining & Repairing PCs, Bigelow's, TMH
6. Lamport L. LATEX: a document preparation system: user's guide and reference manual. Addison-wesley; 1994.

<table>
<tr><td>Course Title</td><td colspan="5">Chemistry Lab</td><td colspan="3">B.Tech II SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2023207</td><td rowspan="2">Engineering Science Course
(ESC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to verify the fundamental concepts with experiments.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Determine the cell constant and conductance of solutions.</td></tr>
<tr><td>CO 2</td><td colspan="8">Synthesis of advanced polymer Bakelite.</td></tr>
<tr><td>CO 3</td><td colspan="8">Calculate the strength of an acid present in secondary batteries.</td></tr>
<tr><td>CO 4</td><td colspan="8">Illustrate the IR of some organic compounds</td></tr>
<tr><td>CO 5</td><td colspan="8">Explain acid-base titrations using pH metry.</td></tr>
</table>

List of Experiments

1. Conductometric titration of strong acid vs. strong base
2. Conductometric titration of weak acid vs. strong base
3. pH metric titration of strong acid vs. strong base
4. pH metric titration of weak acid vs. strong base
5. Determination of cell constant and conductance of solutions
6. Potentiometry - determination of redox potentials and emfs
7. Determination of Strength of an acid in Pb-Acid battery
8. Preparation of Bakelite
9. Verify Lambert-Beer’s law
10. Thin layer chromatography
11. Identification of simple organic compounds by IR
12. Preparation of nanomaterials by precipitation
13. Estimation of Ferrous Iron by Dichrometry

<table>
<tr><td>Course Title</td><td colspan="4">Electrical Circuits Analysis - I Lab</td><td colspan="3">B.Tech II SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002208</td><td rowspan="2">Engineering Science Course (ESC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to determine active, reactive, apparent power for single phase AC circuits, calculation of self and mutual inductances and coefficient of coupling. Verification of Kirchhoff's laws and network theorems for DC excitation.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the Kirchhoff's laws theoretically and practically for any given circuit.</td></tr>
<tr><td>CO 2</td><td colspan="8">Obtain the value of 'K' for a single phase transformer.</td></tr>
<tr><td>CO 3</td><td colspan="8">Determine the active, reactive and apparent power for single phase ac circuits.</td></tr>
<tr><td>CO 4</td><td colspan="8">Apply theorems for a given DC circuits and verify theoretically & practically</td></tr>
</table>

List of Experiments

1. Verification of KCL and KVL
2. Determination of Self, Mutual Inductances and Coefficient of Coupling
3. Verification of Thevenin's Theorems
4. Verification of Norton's Theorems
5. Verification of Superposition Theorem
6. Verification of Maximum Power Transfer Theorem
7. Verification of Reciprocity Theorems
8. Measurement of Active, Reactive and Apparent Power for Single Phase AC Circuits
9. Measurement of 3-Phase Active Power by One Wattmeter Method
10. Measurement of 3-Phase Power by Two Wattmeter Method for Unbalanced Loads

Course Title	Electronic Devices & Circuits Lab					B.Tech II SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2004209	**Engineering Science Course (ESC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**3**	**1.5**	**40**	**60**	**100**
						End Exam Duration : 3Hrs		

Course Objectives: The objective of the course is to verify theoretically and practically all the experiments, analyze the characteristics of Diodes, BJT, MOSFET, UJT, design the amplifier circuits from the given specifications and model the electronic circuits using tools such as PSPICE/Multisim.

Course Outcomes: On successful completion of this course, the students will be able to,

CO 1	Understand the basic characteristics and applications of basic electronic devices
CO 2	Observe the characteristics of electronic devices by plotting graphs.
CO 3	Analyze the Characteristics of UJT, BJT, MOSFET
CO 4	Design MOSFET / BJT based amplifiers for the given specifications
CO 5	Simulate all circuits in PSPICE /Multisim

<u>List of Experiments</u>

Note: All the experiments shall be implemented using both Hardware and Software.

1. Verification of Volt- Ampere characteristics of a PN junction diode and find static, dynamic and reverse resistances of the diode from the graphs obtained.
2. Design a full wave rectifier for the given specifications with and without filters, and verify the given specifications experimentally. Vary the load and find ripple factor. Draw suitable graphs.
3. Verify various clipping and clamper circuits using PN junction diode and draw the suitable graphs.
4. Design a Zener diode-based voltage regulator against variations of supply and load. Verify the same from the experiment.

5. Study and draw the output and transfer characteristics of MOSFET (Enhance mode) in Common Source Configuration experimentally. Find Threshold voltage (V_T), g_m, & K from the graphs.
6. Study and draw the output and transfer characteristics of MOSFET (Depletion mode) or JFET in Common Source Configuration experimentally. Find I_{DSS}, g_m, & V_P from the graphs.
7. Verification of the input and output characteristics of BJT in Common Emitter configuration experimentally and find required h – parameters from the graphs.
8. Study and draw the input and output characteristics of BJT in Common Base configuration experimentally, and determine required h – parameters from the graphs.
9. Evaluate Causes of population explosion, value education and welfare programmes
10. the Volt Ampere characteristics of UJT and determine η, I_P, I_v, V_P, &Vv from the experiment.
11. Design and analysis of voltage- divider bias/self-bias circuit using BJT.
12. Design and analysis of voltage- divider bias/self-bias circuit using JFET.
13. Design and analysis of self-bias circuits using MOSFET.
14. Design a suitable circuit for switch using CMOSFET/JFET/BJT.
15. Design a small signal amplifier using MOSFET (common source) for the given specifications. Draw the frequency response and find the bandwidth.
16. Design a small signal amplifier using BJT(common emitter) for the given specifications. Draw the frequency response and find the bandwidth.

Tools / Equipment Required: Software Tools Like Multisim/ Pspice or Equivalent, DC Power supplies, Multimeters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROs, all the required active devices.

<table>
<tr><th>Course Title</th><th colspan="5">Environmental Science</th><th colspan="3">B.Tech II SEM EEE (R20)</th></tr>
<tr><th>Course Code</th><th>Category</th><th colspan="3">Hours/Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">20MC210</td><td rowspan="2">Mandatory Course (MC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>-</td><td>40</td><td>–</td><td>40</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3"></td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to get awareness of the environment, understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life and to save earth from the inventions by the engineers.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Explain multidisciplinary nature of environmental studies and various Renewable and Nonrenewable resources</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand Energy flow, biogeochemical cycles and ecological pyramids</td></tr>
<tr><td>CO 3</td><td colspan="8">Illustrate various causes of pollution and related preventive measures.</td></tr>
<tr><td>CO 4</td><td colspan="8">Summarize Solid waste management, Social issues related to environment and their protection acts.</td></tr>
<tr><td>CO 5</td><td colspan="8">Evaluate Causes of population explosion, value education and welfare programmes</td></tr>
</table>

UNIT-I

Multidisciplinary Nature Of Environmental Studies: –Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable resources – Natural resources and associated problems

Forest resources: deforestation, case studies – Mining, dams and other effects on forest and tribal people

Water resources: Use and over utilization of surface and ground water conflicts over water. Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy resources: Renewable &Non-Renewable.

UNIT II

Ecosystems: Concept of an ecosystem. – Structure and function of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Food chains, food web- Ecological succession and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Desert ecosystem, Aquatic ecosystems (lakes, rivers and oceans).

Biodiversity and its Conservation : Introduction, Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global levels – India as a mega-diversity nation – Hot-spots of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III

Environmental Pollution: Definition, Cause, effects and control measures of: Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, Thermal pollution and Nuclear hazards.

Solid Waste Management: Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: floods, earthquake, cyclone and landslides.

UNIT – IV

Social Issues And The Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, its problems and concerns. Case studies – **Environmental ethics:** Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents.

Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act.

UNIT – V

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programmes. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health.

Field Work: Visit to a local area to document environmental assets River/forest grassland/hill/mountain – Visit to a local polluted site- Urban/Rural/Industrial/Agricultural Study of common plants, insects, and birds – river, hill slopes, etc.

Text Books:

1. Text book of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, "Environmental Studies", Pearson education
3. S.Azeem Unnisa, "Environmental Studies" Academic Publishing Company
4. K.Raghavan Nambiar, "Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus", Scitech Publications (India), Pvt. Ltd.

Reference Books:

1. Deeksha Dave and E. Sai Baba Reddy, "Textbook of Environmental Science ", Cengage Publications.
2. M. Anji Reddy, "Text book of Environmental Sciences and Technology", BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, "Environmental Sciences and Engineering", Prentice hall of India Private limited
5. G.R.Chatwal, "A Text Book of Environmental Studies" Himalaya Publishing House

B.Tech III SEM EEE (R20)

<table>
<tr><td>Course Title</td><td colspan="5">Switching Theory & Logic Design</td><td colspan="3">B.Tech III SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002301</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: This course provides in-depth knowledge of switching theory and the design techniques of digital circuits, which is the basis for design of any digital circuit.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Change numeric information in different forms</td></tr>
<tr><td>CO 2</td><td colspan="8">Change simple Boolean expressions using the theorems and postulates of Boolean algebra and to minimize combinational functions</td></tr>
<tr><td>CO 3</td><td colspan="8">Design and analyze small combinational circuits and to use standard combinational functions/building blocks to build larger more complex circuits.</td></tr>
<tr><td>CO 4</td><td colspan="8">Design and analyze small sequential circuits and devices and to use standard sequential functions/building blocks to build larger more complex circuits.</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand different types of Programmable Logic Devices</td></tr>
</table>

UNIT-I

Number Systems and Codes: Introduction to Number systems, Basic Conversion Methods, Arithmetic's of Number systems, Complements of Numbers- 1's complement,2's Complement,9's complement,10's complement, Classification of Binary Codes-BCD Code ,XS-3 Code, Gray Code, Error detection and Correction

UNIT-II

Logic Gates and Boolean algebra: Basic Logic Gates, Universal Gates, XOR gate and it's Properties, Boolean Algebra-logic Operations, Laws, Boolean Expression in SOP and POS Form, Minimization of Switching Functions using K-Maps-2 variable,3 variable,4 variable, Don't Care Combination, tabulation Method.

UNIT-III

Combinational Circuits: Introduction, Adders-Half Adder, Full Adder ,Subtractors-Half Subtractor, Full Subtractor, Realization of Adder and Subtractor using Universal gates, Look Ahead carry adder, BCD Adder, Multiplexers, De-multiplexers, Encoders, Decoders.

UNIT-IV

Sequential Circuits: Introduction, Flip Flops- Truth Table, Characteristic Table and Excitation Tables, Conversion of Flip-Flops, Shift Registers-SISO, SIPO, PISO, PIPO, Bidirectional and Universal Shift Registers, Counters-Design of Synchronous and Asynchronous Counters, Ring Counter, Johnson's counter.

UNIT-V

Programmable Logic Devices: Introduction to PLC, ROM Organization, Types of ROMs, PAL,PLA, PROM, Comparison of PLD's.

Text Books:

1. Morris Mano, "Digital Design", PHI, 3rd Edition, 2006.
2. A. Anand Kumar, "Switching Theory & Logic Design", 2008, PHI.

Reference Books

1. R.P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009..
2. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill, 1989.

<table>
<tr><td>Course Title</td><td colspan="5">Electromagnetic Field Theory</td><td colspan="3">B.Tech III SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002302</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the concepts of electric and magnetic fields under static conditions which will be used in theory of transmission lines and electrical machines.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand electric and magnetic fields due to electric charges and Steady Currents, time varying electric and magnetic fields.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze Maxwell's equations for both time variant and invariant electric and magnetic fields.</td></tr>
<tr><td>CO 3</td><td colspan="8">Evaluate electric fields and magnetic fields by various laws such as Coulomb's Law, Gauss's Law, Biot Savart's law, Ampere's circuital law. etc.</td></tr>
<tr><td>CO 4</td><td colspan="8">Determine potential, potential gradient, electric dipole, current and current density, polarization, boundary conditions and capacitance of a capacitor.</td></tr>
<tr><td>CO 5</td><td colspan="8">Determine force, torque, self inductance, statically and dynamically induced EMFs and displacement current.</td></tr>
</table>

UNIT - I

Electric Field & Gauss Law: Coulomb's law, electric field intensity (efi), efi due to a line charge, surface charge and volume charge, work done in moving a point charge in an electric field, gauss law, gauss law using infinite line charge and coaxial cable, gauss law in point form (Maxwell first law, div($\mathbf{D}$) = ρ_v), numeric problems

Electric Potential & Dipole: Electric potential, potential gradient electric dipole, dipole moment – potential & EFI due to an electric dipole, numerical problems.

UNIT - II

Conductors: Current and current density, conduction and convection current densities, continuity equation, behavior of conductors in electric fields, ohm's law in point form, numeric problems.

Polarization & Capacitance: Polarization, boundary conditions – dielectric - conductor, dielectric - dielectric. capacitance – capacitance of parallel plate, spherical and co-axial capacitors, numeric problems.

UNIT - III

Magneto Static Fields: Biot-savart's law, MFI due to a straight current carrying filament, circular and solenoid current carrying wire. maxwell's second equation,

Ampere's Law: Ampere's circuital law and its applications, ampere's circuital law in point form, maxwell third equation , numerical problems. Scalar and Vector magnetic Potential.

UNIT - IV

Magnetic Force: Lorentz force equation, Force on a current element in a magnetic field, Force on a straight and long current carrying conductors in magnetic fields, the force between two and straight parallel current carrying conductors, Numeric Problems.

Torque & Inductance: Torque on a current loop placed in a magnetic dipole. Self Inductance, Application of self inductance of a Solenoid and Toroid, numerical Problems

UNIT - V

Time varying Fields: Faraday's laws of electromagnetic induction, its integral and point forms, Maxwell's fourth equation. statically and dynamically induced emfs, modification of maxwell's equation for time varying fields, displacement current, and maxwell's equation in differential and integral form, numerical problems.

Text Books:

1. Principles of Electromagnetics, Mathew N. O. Sadiku, Oxford (I) student 4th edition
2. Engineering Electromagnetics, William H. Hayt and John A. Buck, TMH, 7th edition 2006.

Reference Books:

1. Electromagnetic Fields, TVS Arun Murthy, S. Chand & Company Ltd., 1st edition 2008
2. Field Theory, K. A. Gangadhar, P. M. Ramanathan, Khanna Publishers, 15th edition, 2003.

<table>
<tr><td>Course Title</td><td colspan="5">Electrical Circuit Analysis - II</td><td colspan="3">B.Tech III SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002303</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the concept of locus diagrams, the application of resonance, transients applied for ac and dc circuits, necessary conditions for network functions, various parameters and its relationships.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the basic concepts of resonance, network functions and locus diagrams.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze R-L,R-C and R-L-C circuits for DC and AC transient response.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze two port network behavior for various parameters.</td></tr>
<tr><td>CO 4</td><td colspan="8">Evaluate the time domain response for various DC and AC networks.</td></tr>
</table>

UNIT - I

Resonance: Series, parallel circuits, concept of half power frequencies, bandwidth and q factor. simple problems.

Locus diagrams: Impedance and admittance locus diagrams of series and parallel combinations R-L, R-C, R-L-C with variation of various parameters.

UNIT - II

Network Functions: Single port and multiport networks, immittance functions of two port parameters, necessary conditions for driving point and transfer functions, poles and zeros, time domain response from pole zero plots, restrictions from pole zero locations.

UNIT - III

Two Port Networks: Two port networks, impedance, admittance, transmission parameters, hybrid and inverse hybrid parameters, relationships between parameters, conditions for symmetry and reciprocity.

UNIT - IV

DC Transient Analysis: Determination of initial conditions – transient response of R-L, R-C and R-L-C circuits for DC–solution method using differential equation and laplace transforms.

UNIT - V

AC Transient Analysis: Transient response of R-L, R-C and R-L-C series circuits for sinusoidal excitations – solution method using differential equation and laplace transforms.

Text Books:

1. Networks and Systems – D. Roy Chowdari – New Age International
2. Network Analysis – Van Valkenburg - 3rd edition.

Reference Books:

1. Circuits & Networks – A. Sudhakar, Shayammohan. S. Pillai, 4th Edition – TMH.
2. Electrical Circuits - N. Sreenivasulu.

Course Title	Electrical Measurements & Measuring Instruments					B.Tech III SEM EEE (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2002304	Professional Core (PCC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	--	--	3	40	60	100
Mid Exam Duration : 2Hrs						End Exam Duration : 3Hrs		
Course Objectives: The objective of the course is to learn about the measuring instruments, ac and dc bridges, instrument transformer, potentiometer and CRO.								
Course Outcomes: On successful completion of this course, the students will be able to,								
CO 1	Classify the types of instruments and bridges.							
CO 2	Choose a suitable instrument to measure Voltage, Current, Power, Energy and Lissajous patterns.							
CO 3	Determine circuit parameters using Bridges.							
CO 4	Measure Phase angle errors from CT's and PT's, magnitude and frequency from the CRO.							

UNIT - I

Measuring Instruments: Classification, deflecting, control and damping torques, ammeters and voltmeters, PMMC, moving iron, dynamometer type instruments, expression for the deflecting torque and control torque, errors and compensations, extension of range using shunt and multipliers, numeric problems.

UNIT - II

Measurement of Power: Single phase dynamometer wattmeter, expression for deflecting and control torques, types of p.f. meters – dynamometer and moving iron type

Measurement of Energy: Single phase induction type energy meter, driving and braking torques, errors and compensations.

UNIT - III

D.C. Bridges: Method of measuring low, medium and high resistance – sensitivity of Wheatstone's bridge – Kelvin's double bridge for measuring low resistance, measurement of high resistance – loss of charge method.

A.C Bridges: Measurement of inductance - Maxwell's bridge, Anderson's bridge, measurement of capacitance and loss angle, Desauty's bridge, Schering bridge- frequency measurement- wien's bridge.

UNIT - IV

Instrument Transformers: CT and PT – ratio and phase angle errors–design considerations.

Potentiometers: Principle and operation of DC Crompton's potentiometer, standardization, measurement of unknown resistance, current and voltage. a.c. potentiometers: polar and coordinate types, standardization – applications.

UNIT - V

Electronic Measurements: Cathode ray oscilloscope – cathode ray tube – application of CRO – measurement of phase, frequency, current & voltage – Lissajous pattern.

Digital meters: Digital voltmeter – successive approximation, ramp and integrating type.

Text Books

1. Electrical measurements and measuring Instruments – by E.W. Golding and F.C. Widdis, 5th Edition, Reem Publications.
2. Electrical & Electronic Measurement & Instruments by A. K. Sawhney, Dhanpat Rai & Co. Publications.

Reference Books

1. Electrical Measurements: Fundamentals, Concepts, Applications – by Ressland, M.U, New Age International (P) Limited, Publish.
2. Electronic Instrumentation by H. S. Kalsi, Tata Mcgraw Hill Mc, 3rd Edition.

<table>
<tr><td>Course Title</td><td colspan="5">DC Machines & Transformers</td><td colspan="3">B.Tech III SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002305</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn principle, operation, construction, characteristics of dc machines, and transformers.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the principle, operation and constructional details of dc machines and transformers.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the characteristics & parallel operation of dc machines, Speed control and starting of DC motors, phasor diagrams and parallel operation of single phase transformers.</td></tr>
<tr><td>CO 3</td><td colspan="8">Compare losses and efficiency by conducting different test on dc machines and transformers.</td></tr>
<tr><td>CO 4</td><td colspan="8">Illustrate the Auto transformers, Scott connection and connections types of 3-phase transformers.</td></tr>
</table>

UNIT - I

DC Generators: Construction, principle of operation, emf equation, armature reaction, commutation, numerical problems. Types of dc generators, open circuit characteristics, load characteristics of shunt, series and compound generators, parallel operation of dc generators, numeric problems.

UNIT - II

DC Motors: Principle of operation, back emf, torque equation, characteristics and application of series, shunt and compound motors, numerical problems.

Speed Control: Speed control of dc shunt & series motors, starters (3 & 4point) numerical problems.

UNIT - III

Testing of DC Machines: Losses & efficiency, condition for maximum efficiency, brake test, Swinburne's test, Hopkinson's test, field's test, separation of stray losses in a dc motor, numerical problems.

UNIT - IV

1Φ Transformer: Construction, principle of operation, types, emf equation, operation on no load and load, phasor diagrams, equivalent circuit, losses, efficiency & regulation, all day efficiency, numerical problems.

Testing of Transformer: OC & SC tests, Sumpner's test, predetermination of efficiency & regulation, separation of losses test, numeric problems.

UNIT - V

Parallel Operation & Auto transformer: Parallel operation with equal & unequal voltage ratios, auto transformer, equivalent circuit, comparison with two winding transformer, numeric problems.

3Φ Transformer: Types of connections, Y-Y, Y-Δ, Δ-Y, Δ-Δ, open delta, scott connection.

Text Books:

1. Electrical Machines, P. S. Bimbra, Khanna Publishers
2. Electrical Machines, J.B. Gupta, Kataria Publications

Reference Books

1. Electrical Machines, I.J. Nagarath & D.P. Kothari, TMH, 7th Edition 2005
2. Electrical Machinery, A. E. Fitzgerland, C. Kingsley and S. Umlauts, TMH,5th Edition

<table>
<tr><td>Course Title</td><td colspan="4">Electrical Circuits Analysis - II Lab</td><td colspan="3">B.Tech III SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002306</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>--</td><td>--</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to determine and verify various network parameters using simulation software.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Verify DC and AC circuits using MATLAB/SIMULINK</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply theorems for DC and AC circuits using MATLAB/SIMULINK</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze transient response behavior in MATLAB/SIMULINK</td></tr>
<tr><td>CO 4</td><td colspan="8">Determine the two port parameters using MATLAB/SIMULINK</td></tr>
</table>

<u>List of Experiments (Any Eight)</u>

1. Verification of Kirchhoff's current and Voltage law
2. Verification of superposition and reciprocity theorem
3. Verification of compensation theorem
4. Verification of Millman's theorem
5. Determination of average, rms value, form factor, peak factor of sinusoidal wave
6. Determination of Z and Y parameters.
7. Determination of ABCD and h parameters.
8. Analysis of RLC series and parallel resonance.
9. Determine the transient response of RL and RC series networks.
10. Determine the transient response of RLC series networks.

Note: All the above experiments are simulated using MATLAB/OCTAVE/MULTISIM

<table>
<tr><td>Course Title</td><td colspan="5">Electrical Measurements & Measuring Instruments Lab</td><td colspan="3">B.Tech III SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002307</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>--</td><td>--</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to calibrate instruments and measure various circuit parameters.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Compare and calibrate various measuring Instruments.</td></tr>
<tr><td>CO 2</td><td colspan="8">Identify balanced conditions among bridges.</td></tr>
<tr><td>CO 3</td><td colspan="8">Measure the percentage errors among measuring instruments.</td></tr>
</table>

<u>List of Experiments (Any Eight Experiments)</u>

1. Calibration and testing of single phase energy meter
2. Calibration of dynamometer power factor meter.
3. Crompton d.c. potentiometer – calibration of pmmc ammeter and pmmc voltmeter.
4. Kelvin's double bridge – measurement of resistance – determination of tolerance.
5. Measurement of Three Phase Power by using Two Wattmeter Method
6. Schering bridge
7. Anderson bridge
8. Measurement of 3 phase reactive power with single phase wattmeter.
9. Measurement of parameters of a choke using 3 voltmeter and 3 ammeter methods.
10. Calibration LPF wattmeter – by phantom testing.
11. Characteristics of Strain Gauge
12. Study and Calibration of LVDT for Displacement Measurement

<table>
<tr><td>Course Title</td><td colspan="4">DC Machines & Transformers Lab</td><td colspan="3">B.Tech III SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002308</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>--</td><td>--</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn and illustrate the performance of DC machines and transformers.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Analyze performance characteristics of DC machines and transformers</td></tr>
<tr><td>CO 2</td><td colspan="8">Evaluate regulation and efficiency of transformers</td></tr>
<tr><td>CO 3</td><td colspan="8">Distinguish various tests between DC motor and DC generator</td></tr>
</table>

<u>List of Experiments (Any Eight)</u>

1. OCC Characteristics of DC shunt Generator
2. Brake test on DC shunt motor
3. Swinburne’s test
4. Speed control of DC shunt motor
5. Fields test on DC series machines
6. Hopkinson’s test on DC shunt machines
7. Load test on DC shunt generator
8. OC and SC Test on single phase transformer
9. Brake test on DC compound motor
10. Load test on DC compound Generator
11. Load test on DC series generator
12. Sumpner’s test on single phase transformer
13. Scott connection of three phase transformer
14. Load test on single phase transformer

<table>
<tr><td>Course Title</td><td colspan="5">Skill Oriented Course
(Fundamentals of MATLAB Programming)</td><td colspan="3">B.Tech III SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002309</td><td rowspan="2">Skill Course
(SC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>1</td><td>--</td><td>2</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn basic knowledge in MATLAB Programming to solve Electrical Engineering Problems.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the basic features of MATLAB Programming, Array construction methods, operations, Relational & Logical Operators.</td></tr>
<tr><td>CO 2</td><td colspan="8">Illustrate the Polynomial operations.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the Control flow structures IF-ELSE, FOR and WHILE</td></tr>
<tr><td>CO 4</td><td colspan="8">Solve electrical engineering problems using MATLAB Programs.</td></tr>
</table>

Module-1: 10hrs

Basic features: Introduction –Simple math – MATLAB Workspace – About variables – comments, punctuation and aborting execution – Script M-files.

Arrays and Array Operations: Simple arrays – Array addressing – Array construction –Scalar Array Mathematics - Array Array Mathematics –Array size.

Module-2: 10hrs

Control Flow: Relational & Logical operators – For, While Loops, If-Else-End Construction.

Polynomials: Roots, multiplication, addition, division, derivatives and Integrals

Module-3: 10hrs

Electrical Engineering Applications: Solving simple problems in Electrical Circuits, Electrical Machines, Control Systems and Power Systems.

<u>Text books</u>

1. Mastering MATLAB by Hanselman, Littlefield – Pearson Publications, 1st Edition, 2012.
2. MATLAB Programming by David C. Kuncicky -Prentice Hall, 2004

Course Title	Human Values & Professional Ethics					B.Tech III SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20MC310	**Mandatory Course (MC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		2	**-**	**--**	**--**	**40**	**--**	**40**
Mid Exam Duration: 2Hrs						**End Exam Duration : 3Hrs**		

Course Objectives: The objective of the course is to understand the moral values that ought to guide the management profession and resolve the moral issues in the profession, justify the moral judgment concerning the profession, develop a set of beliefs, attitudes, and habits that engineers should display concerning morality, create an awareness on Management Ethics and Human Values, inspire Moral and Social Values and Loyalty and appreciate the rights of others.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Develop appropriate technologies and management patterns to create harmony in professional and personal life.
CO 2	Ensure students sustained happiness through identifying the essentials of human values and skills.
CO 3	Get awareness of types of ethical challenges and dilemmas confronting members of a range of professions (business, media, police, law, medicine, research)
CO 4	Bring to bear ethical analysis and reasoning in the light of normative ethics frameworks on a selection of ethical challenges and dilemmas across the chosen range of professions
CO 5	Relate ethical concepts and materials to ethical problems in specific professions and professionalism

UNIT- I

Human Values: Morals, Values and Ethics - Integrity - Trustworthiness - Work Ethics - Service Learning - Civic Virtue - Respect for others - Living Peacefully - Caring - Sharing - Courage - Value Time - Cooperation - Commitment - Empathy - Self-confidence - Spirituality - Character.

UNIT-II

Engineering Ethics: Senses of Engineering Ethics – Variety of Moral issues – Types of inquiry – Moral Dilemmas – Moral Autonomy – Kohlberg's Theory – Consensus and Controversy – Professions and Professionalism – professional ideals and virtues.

UNIT- III

Engineer's Responsibility for Safety: Safety and Risk – Assessment of Safety and Risk – Risk benefit Analysis – Reducing Risk – The Government Regulator's Approach to Risk – Chernobyl Case and Bhopal Case studies.

UNIT-IV

Value Education: Self- exploration- its content and process- natural acceptance- Happiness and Prosperity- Understanding Human relations.

UNIT-V

Holistic Perception of Harmony: Understanding the Harmony in the society- - Universal order- critical appreciation of Human values- Justice, Trust.

Text Books:

1. Mike Martin and Roland Schinzinger.“ Ethics in Engineering '', McGrow Hill, New York 2005.
2. Charles E Harris. Michael S Pritchard and Michael J Rabins.“ Engineering Ethics – Concepts and Cases ”, Thomson Learning 2000.
3. R R Gaur, R Asthana, G P Bagaria, “A Foundation Course in Human Values and Professional Ethics”, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1.

Reference Books:

1. Charles D Fleddermann, “ Engineering Ethics”, Prentice Hall, New Mexico, 1999.
2. John R Baatright. “Ethics and the Conduct of Business”, Pearson Education 2003.
3. Edmund G Seeabauer and Robert L Barry, “Fundamentals of Ethics for Scientists and Engineers”, Oxford University press 2001.

B.Tech IV SEM EEE (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Special Functions & Complex Analysis</td><td colspan="3">B.Tech IV SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2021401</td><td rowspan="2">Basic Sciences (BSC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of this course is to familiarize the students Bessel functions, Legendre’s equations and the concepts of complex variables to equip the students to solve application problems in their disciplines.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Solve Bessel and Legendre equations in terms of polynomials.</td></tr>
<tr><td>CO 2</td><td colspan="8">Define analytic function, singularities, poles and residues.</td></tr>
<tr><td>CO 3</td><td colspan="8">Determine the differentiation of complex functions used in engineering problems and analyze images from z-plane to w-plane.</td></tr>
<tr><td>CO 4</td><td colspan="8">Discuss the various special transformations.</td></tr>
<tr><td>CO 5</td><td colspan="8">Analyze real definite integrals in definite regions.</td></tr>
</table>

UNIT - I

Bessel functions: Introduction – Recurrence formulae for $J_n(x)$ – Generating function for $J_n(x)$ – Jacobi series – Orthogonality of Bessel functions – Legendre’s equation – Rodrigue’s formula, Legendre Polynomials – Generating function for $P_n(x)$ - Recurrence formulae for $P_n(x)$ – Orthogonality of Legendre polynomials.

UNIT - II

Functions of a complex variable: Limit – Continuity -Differentiability – Analytic function – Properties – Cauchy – Riemann equations in cartesian and polar coordinates – Harmonic and Conjugate harmonic functions. Construction of analytic function using Milne’s Thomson method.

UNIT - III

Conformal Mapping: Some standard transforms – translation, rotation, magnification, inversion and reflection. Bilinear transformation – invariant points. Special conformal transformations: $w = e^z$, z^2, sinz and cosz.

UNIT - IV

Complex integration: Line integral - Evaluation along a path – Cauchy's theorem – Cauchy's integral formula – Generalized integral formula. Singular point – Isolated singular point – Simple pole, Pole of order *m* – Essential singularity.

UNIT - V

Residues: Evaluation of residues by formula. Cauchy's residue theorem – Evaluation of the real definite integrals of the type (i) Integration around the unit circle (ii) integration around a small semi circle

Text Books:

1. Higher Engineering Mathematics, Dr. B.S Grewal, Khanna Publishers.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 9^{th} edition.

Reference Books:

1. Higher Engineering Mathematics, B.V.Ramana, Mcgraw Hill Education(India) Private Limited.
2. Engineering Mathematics, Volume – III , E. Rukmangadachari & E. Keshava Reddy, Pearson Publisher.

<table>
<tr><td>Course Title</td><td colspan="4">Fundamentals of
Management for Engineers</td><td colspan="3">B.Tech IV SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2025402</td><td rowspan="2">HSMC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to understand the functions and responsibilities of managers, provide them tools and techniques to be used in the performance of the managerial job, enable them to analyze and understand the environment of the organization and to develop cognizance of the importance of management principles.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Know and understand principles, functions, approaches and theories of Management.</td></tr>
<tr><td>CO 2</td><td colspan="8">Use problem solving strategies and critical thinking skills in real life situations.</td></tr>
<tr><td>CO 3</td><td colspan="8">Design organization structures and understand the concept of Human Resource Management in present Competitive Organizations.</td></tr>
<tr><td>CO 4</td><td colspan="8">Recognize and Describe the role of leaders in business and other types of Organizations.</td></tr>
<tr><td>CO 5</td><td colspan="8">Explain the basic control process, monitoring points and describes the different levels and types of controls.</td></tr>
</table>

<u>UNIT – I</u>

Introduction to Management: Definition, Nature and Scope, Functions, Managerial Roles, Levels of Management, Managerial Skills, Challenges of Management; Evolution of Management- Classical Approach- Scientific and Administrative Management; The Behavioral approach; The Quantitative approach; The Systems Approach; Contingency Approach, IT Approach.

<u>UNIT – II</u>

Planning and Decision Making: General Framework for Planning: Planning Process, Types of Plans, Management by Objectives, Development of Business Strategy. Decision making and Problem solving: Programmed and Non Programmed Decisions, Steps in Problem Solving and Decision Making; Bounded Rationality and Influences on Decision Making.

UNIT – III

Organization Structures and HRM: Principles of Organization: Organizational Design & Organizational Structures. Organizational Culture; Organizational Climate and Organizational Change.

Human Resource Management & Business Strategy: Talent Management, Talent Management Models and Strategic Human Resource Planning; Recruitment and Selection; Training and Development; Performance Appraisal.

UNIT – IV

Leading and Motivation: Leadership, Power and Authority, Leadership Styles; Behavioral Leadership, Situational Leadership, Leadership Skills, Leader as Mentor and Coach, Leadership during adversity and Crisis; Handling Employee and Customer Complaints, Team Motivation - Types of Motivation; Relationship between Motivation, Performance and Engagement, Content Motivational Theories.

UNIT – V

Controlling: Control, Types and Strategies for Control, Steps in Control Process, Budgetary and Non- Budgetary Controls. Characteristics of Effective Controls, Establishing control systems, Control frequency, and Methods.

Text Books:

1. Management Fundamentals, Robert N Lussier, 5e, Cengage Learning, 2013.
2. Fundamentals of Management, Stephen P. Robbins, Pearson Education, 2009.

Reference Books:

1. Essentials of Management, Koontz Kleihrich, Tata McGraw Hill.
2. Management Essentials, Andrew DuBrin, 9e, Cengage Learning, 2012

<table>
<tr><td>Course Title</td><td colspan="4">Induction Motors & Synchronous Machines</td><td colspan="4">B.Tech IV SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002403</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn principles, operation, construction, characteristics and starting methods of induction motor and synchronous machines.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand Constructional details, working, characteristics, starting methods of synchronous machines and induction motors.</td></tr>
<tr><td>CO 2</td><td colspan="8">Distinguish torque-speed curves and Speed control methods of induction motors.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the regulation, synchronization, hunting of synchronous machines and power factor improvement.</td></tr>
<tr><td>CO 4</td><td colspan="8">Evaluate the performance of three phase induction machines and synchronous machines by direct and indirect tests.</td></tr>
</table>

UNIT - I

3-Φ Induction Motors: Production of rotating magnetic field - construction, types (squirrel cage and slip-ring), torque slip characteristics, starting and maximum torque, equivalent circuit. phasor diagram, losses and efficiency, circle diagram construction.

UNIT - II

Starting methods: Methods of starting for induction motors

1-ø Induction Motor: Introduction - double field revolving theory– equivalent circuit – determination of equivalent parameters- problems - starting methods – resistance & capacitance split phase and shaded pole motors.

UNIT - III

Synchronous Generators: Constructional details of synchronous machines, armature windings, distribution, pitch and winding factors - emf equation; armature reaction, concept of leakage flux, synchronous reactance, equivalent circuit, phasor diagram, voltage regulation, determination of regulation by synchronous impedance method, MMF and ZPF method.

UNIT - IV

Salient Pole Machines: Theory of salient pole machines, phasor diagrams, and determination of X_d and X_q from slip test, expression for power output of salient pole and cylindrical pole synchronous generators, power angle characteristics, Synchronizing power and torque.

Parallel Operation: Conditions for parallel operations, synchronizing and load sharing of synchronous generators

UNIT - V

Synchronous Motors: Principle of operation, methods of starting, phasor diagram of synchronous motor, variation of current and power factor with excitation, hunting and use of damper bars, synchronous condenser and power factor correction.

Text Books:

1. Electric Machines by I. J. Nagrath and D. P. Kothari, TMH Publishers, 4th Edition 2010.
2. Electrical Machines by P. S. Bimbhra, Khanna Publishers.

Reference Books:

1. Electro mechanics – II & III (Induction Motors, Synchronous and Single Phase Machines) by S. Kamakashiah, Overseas Publishers Private Ltd.
2. The Performance and Design of AC Machines, M. G. Say, ELBS and Pitman & Sons.

<table>
<tr><td>Course Title</td><td colspan="4">Linear Control Systems</td><td colspan="3">B.Tech IV SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002404</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn mathematical modeling of physical systems, electrical systems, time response of first order and second order Systems, stability analysis using time domain and frequency domain and design compensator in frequency domain to improve the performance.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand modeling of physical systems, time and frequency domain specifications and stability of the system.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the stability of the system in time and frequency domains.</td></tr>
<tr><td>CO 3</td><td colspan="8">Evaluate the transfer function using block diagram reduction technique and signal flow graph, steady state error and static error constants.</td></tr>
<tr><td>CO 4</td><td colspan="8">Design lag, lead, lag-lead compensators in frequency domain.</td></tr>
</table>

UNIT - I

Control System Concepts: Introduction to control systems, classification, transfer function, effect of feedback, mathematical modeling of physical systems, block diagram, reduction techniques, signal flow graphs and mason’s gain formula, transfer function of simple electrical systems.

UNIT - II

Time Domain Analysis: Standard test signals, time response of first and second order systems- time response specifications, steady state error and error constants, response of P, PI, and PID controllers.

UNIT - III

Concept of Stability and Root Locus: The concept of stability, necessary conditions for stability – Routh Hurwitz’s criterion – limitations of Routh’s stability – Root locus concept – construction of Root loci, effect of poles & zeros on stability.

UNIT - IV

Frequency Domain Analysis: Introduction, correlation between time and frequency response, frequency domain specifications, bode plots, Polar plots - gain and phase margin.

UNIT - V

Compensation Techniques: System design and compensation – realization of basic lead, lag and lead – lag cascade compensations in frequency domain.

Text Books{

1. "Control Systems Engineering" by I. J. Nagrath and M. Gopal, New Age International (P) Limited, Publishers, 5th edition, 2007..
2. "Control Systems" by A. Anand Kumar, Prentice Hall of India Pvt. Ltd.

Reference Books

1. "Modern Control Engineering" by Katsuhiko Ogata, Prentice Hall of India Pvt. Ltd., 5th edition, 2010.
2. "Control Systems Engineering" by NISE, 5th edition, John Wiley.

Course Title	Power Systems - I				B.Tech IV SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002405	**Professional Core (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**--**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration : 2Hrs						**End Exam Duration : 3Hrs**		

Course Objectives: The objective of the course is to learn conventional & non conventional energy sources, economic aspects mechanical and electrical design of transmission lines, and underground cables.

Course Outcomes: On successful completion of this course, the students will be able to,

CO 1	Understand the basic concepts of various generating systems and its load characteristics.
CO 2	Understand the construction and types of cables used for underground.
CO 3	Analyze the mechanical aspects of transmission lines and corona phenomenon.
CO 4	Evaluate inductance and capacitance of transmission lines and grading of underground cables.
CO 5	Determine the cost of electrical energy, tariff charges on consumers.

UNIT - I

Thermal, Hydro & Nuclear Power Stations: Line diagram & its explanation for thermal, hydro & nuclear power stations, and principle of operation of nuclear reactor.

UNIT - II

Economic Aspects of Power Generation: Load curve, load duration curve, integral load duration curves, load factor, demand factor, diversity factor, capacity factor, utilization factor and plant use factors-numerical problems.

Choice of size and number of generating units, cost of electrical energy, problems, types of tariff charges on consumers – numerical problems.

UNIT - III

Mechanical Design of Transmission Lines: Insulators, types of insulators, string efficiency, methods of improving string efficiency, numerical problems.

Sag and tension calculations for equal and unequal heights of towers, effect of wind and ice on weight of conductors, numerical problems.

UNIT - IV

Electrical Design of Transmission Lines: Types of conductors, calculation of resistance for solid conductor, concept of GMR & GMD, calculation of inductance and capacitance for 1Φ and 3Φ single and double circuit lines, symmetrical and asymmetrical conductor configuration with and without transportation, effect of earth on capacitance - numerical problems.

UNIT - V

Underground Cables: Construction, types of cables, insulation in cables, calculation of insulation resistance and stress in insulation. capacitance of single and 3 core belted cables. grading of cables, capacitance grading, description of intersheath grading, numeric problems.

Corona: Description of corona phenomenon, factors affecting corona, critical disruptive voltage, visual disruptive voltage and power loss, radio interference, numeric problems.

Text Books

1. Electrical power systems - by C. L. Wadhwa, New Age International (P) Limited, Publishers, 4th Edition, 2005.
2. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar, A. Chakrabarti, Dhanpat Rai & Co Pvt. Ltd., 2003.

Reference Books

1. Principles of power systems by V.K.Mehta, S Chand publishers.
2. Electric Power Systems by S. A. Nasar, Schaum Outline Series, TMH, 3rd Edition, 2008.

Course Title	**Induction Motors & Synchronous Machines Lab**					**B.Tech IV SEM EEE (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002406	**Professional Core (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		--	**--**	**3**	**1.5**	**40**	**60**	**100**
						End Exam Duration : 3Hrs		
Course Objectives: The objective of the course is to analyze the performance of various AC machines like induction motors and synchronous machines.								
Course Outcomes: On successful completion of this course, the students will be able to,								
CO 1	Identify parts of transformers and AC machines.							
CO 2	Determine the performance of AC machines.							
CO 3	Choose the apparatus in experimental circuit based on loading and rating of the AC machines.							

List of experiments (Any Eight)

1. Brake test on Three Phase Induction Motor
2. No-load & Blocked rotor Tests on Three Phase Induction Motor
3. Speed Control of three phase Induction Motor
4. Equivalent Circuit of a Single Phase Induction Motor
5. Determination of X_d and X_q of a Salient Pole Synchronous Machine
6. Load test of a three phase alternator by Resistive, Inductive and Capacitive Loading
7. Regulation of a Three –Phase Alternator by Synchronous Impedance Method
8. Regulation of Three Phase Alternator by Z.P.F. Method.
9. V and Inverted V Curves of a 3 Phase Synchronous Motor.
10. Determination of transient, sub-transient and steady state reactance of an alternator.

<table>
<tr><th>Course Title</th><th colspan="5">Control Systems Lab</th><th colspan="3">B.Tech IV SEM EEE (R20)</th></tr>
<tr><th>Course Code</th><th>Category</th><th colspan="3">Hours/Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">2002407</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>--</td><td>--</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the performance of a second order system, PID controller, synchros and characteristics of servo motor. Stability analysis in time and frequency domain, state space analysis in MATLAB.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the performance of second order system, PID controller, synchros and armature voltage controlled DC motor.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the characteristics of magnetic amplifier and servo motor.</td></tr>
<tr><td>CO 3</td><td colspan="8">Evaluate stability of linear systems in time and frequency domain using MATLAB.</td></tr>
<tr><td>CO 4</td><td colspan="8">Convert transfer function to state space and vice versa using MATLAB.</td></tr>
</table>

List of the experiments (Any Ten - 8 from Conventional, 2 from MATLAB)

1. Time response of Second order system
2. Characteristics of Synchros
3. Effect of feedback on DC servo motor
4. Transfer function of DC Machine
5. Effect of P, PI, PID Controller on a second order systems
6. Characteristics of magnetic amplifiers
7. Characteristics of AC servo motor
8. Lag and lead compensator design in the frequency domain using MATLAB.
9. Linear system analysis (Time domain analysis) using MATLAB.
10. Stability analysis (Bode, Root Locus) of Linear Time Invariant system using MATLAB
11. State space model for classical transfer function using MATLAB – Verification.

<table>
<tr><td>Course Title</td><td colspan="4">Python Programming Lab</td><td colspan="3">B.Tech IV SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2005408</td><td rowspan="2">Engineering Sciences (ESC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>--</td><td>--</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn syntax and semantics, create functions in python, Handle Strings and files in Python, understand lists, dictionaries and regular expressions in Python.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Examine python syntax and semantics and be fluent in the use of python flow control and functions.</td></tr>
<tr><td>CO 2</td><td colspan="8">Demonstrate proficiency in handling Strings and file Systems.</td></tr>
<tr><td>CO 3</td><td colspan="8">Create, run and manipulate Python programs using core data structures like lists, dictionaries and regular Expressions.</td></tr>
</table>

List of Experiments (Any Eight)

1. Compute the GCD of two numbers.
2. Find the square root of a number (Newton’s method)
3. Exponentiation (power of a number)
4. Find the maximum of a list of numbers
5. Linear search and Binary search
6. Selection sort, Insertion sort
7. Merge sort
8. First ‘n’ prime numbers
9. Multiply matrices
10. Programs that take command line arguments (word count)
11. Find the most frequent words in a text read from a file
12. Simulate elliptical orbits in Pygame
13. Simulate bouncing ball using Pygame

Software Required: Python 3 interpreter for Windows/Linux.

<table>
<tr><td>Course Title</td><td colspan="4">Skill Oriented Course
(2-D Graphics & Symbolic Processing Using MATLAB)</td><td colspan="3">B.Tech IV SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002409</td><td rowspan="2">Skill Course
(SC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>1</td><td>--</td><td>2</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the knowledge on graphical representation of data using Two Dimensional Graphical features in MATLAB and to gain knowledge to solve problems using symbolic processing techniques.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand basic features of Two-Dimensional graphics.</td></tr>
<tr><td>CO 2</td><td colspan="8">Illustrate subplots, interactive plotting tools and specialized 2-D plots.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze Interpolation and Curve fitting techniques.</td></tr>
<tr><td>CO 4</td><td colspan="8">implement symbolic techniques for problem solving.</td></tr>
</table>

Module-1: 10hrs

2-D Graphics: The Plot function - Line styles, Markers and Colors – Plot Grids, Axes Box, Labels – Multiple plots – Multiple Figures – Subplots – Interactive plotting tools.

Module-2: 10hrs

Specialized 2-D plots–area, fill, bar, pie, stairs and stem.Data Interpolation and curve fitting.

Module-3: 10hrs

Symbolic Processing: Symbolic Expressions and Algebra – Manipulating Trigonometric expressions – Evaluating and Plotting Symbolic Expressions – Solving Algebraic and Transcendental equations - Calculus.

<u>Text books:</u>

1. Mastering MATLAB by Hanselman, Littlefield– Pearson Publications, 1^{st} Edition, 2012.
2. MATLAB Programming by David C. Kuncicky -Prentice Hall, 2004.

B.Tech V SEM EEE (R20)

Course Title	Linear and Digital IC Applications					B.Tech V SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002501	**Professional Core (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration : 2Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to learn the Op-Amps, Timers and PLLs, applications of Op-Amps, Introduce **Verilog** and its language elements to design digital systems, Design of different combinational and sequential digital circuits.								
Course Outcomes: On successful completion of this course, the students will be able to,								
CO 1	Understand the operation and characteristics of OP-AMPs.							
CO 2	Analyze multivibrator circuits and 555 timers using OP-AMPs.							
CO 3	Apply PLL in various Communication applications.							
CO 4	Compare various digital logic families.							
CO 5	Simulate digital logic circuits using Verilog HDL.							

UNIT-I

Op-Amp & its Characteristics : Integrated circuits -types, classification, package types and temperature ranges, power supplies, OP-Amp Block diagram, ideal and practical OP-Amp specifications, DC and AC characteristics, 741 OP-Amp and its features, Inverting and non-inverting amplifier.

UNIT-II

Op-Amp Applications: Integrator and differentiator, difference and instrumentation amplifier, AC amplifier, V-I, I-V converters, comparators, Multivibrators, Triangular and square wave generators, Log and antilog amplifiers, precision rectifiers.

UNIT-III

Timers & Phase Locked Loops: Introduction to 555 Timer, functional diagram, Monostable and Astable operations, Schmitt Trigger, PLL-Introduction, Block schematic, principles and description of individual blocks, 565 PLL, applications.

UNIT–IV

Unipolar & Bipolar Logic Families: Introduction to logic families, CMOS logic, CMOS steady state electrical behavior, CMOS dynamic state electrical behavior, CMOS logic families, Bipolar logic, transistor logic, TTL families, CMOS/TTL interfacing, ECL, Comparison of logic families.

UNIT–V

Verilog HDL & Design Examples: HDL based Design flow, Program Structure, Logic system, Nets, Variables and Constants, Vectors and Operators, Arrays, Logical Operators and Expressions. Structural design elements, data flow design elements, behavioral design elements (procedural code). Design using basic gates, Decoders, Encoders, Multiplexers and

Demultiplexers, Adders, Subtractors, SSI Latches and Flip-Flops, Counters, Design of Counters and Shift Registers .**Verilog** Modules for the above ICs.

<u>Text Books</u>

1. Ramakanth A. Gayakwad, “Op-Amps & Linear ICs”, 4th edition, PHI, 1987.
2. John F. Wakerly, “Digital Design Principles & Practices” PHI/Pearson Education Asia, 4th Edition, 2008.
3. J. Bhasker, “A Verilog HDL Primer”, Star Galaxy Publishing; 3rd edition (January 31, 2005)

<u>Reference Books:</u>

1. D. Roy Chowdhury, “Linear Integrated Circuits”, New Age International (P) Ltd, 2nd Edition, 2003.
2. James M.Fiore, “Operational Amplifiers & Linear integrated circuits & applications”, Cengage 2009.
3. Fundamentals of Digital Logic with Verilog Design – Stephen Brown, Zvonko Vranesic, TMH, 3rd Edition, 2014.

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<table>
<tr><td>Course Title</td><td colspan="5">Power Systems - II</td><td colspan="3">B.Tech V SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002502</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn transmission line performance, per unit system, fault analysis on transmission and iterative methods.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand various transmission lines, the formulation of impedance and admittance bus matrices for a power system network, symmetrical and unsymmetrical faults, importance of power flow studies.</td></tr>
<tr><td>CO 2</td><td colspan="8">Evaluate the performances of transmission lines and Y_{bus} for a given power system network.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze per unit quantities and fault calculations for various types of faults.</td></tr>
<tr><td>CO 4</td><td colspan="8">Investigate the load flow studies using different iterative techniques.</td></tr>
</table>

UNIT - I

Performance of Transmission Lines: Classification of transmission lines – short, medium and long line and their model representation – estimation of regulation and efficiency by nominal T, nominal π and rigorous methods - problems. equivalent T and π, surge impedance loading, Ferranti effect.

UNIT - II

System Modeling: Representation of power system components– per unit representations and advantages – single line diagram representation – impedance and reactance diagram – changing the base of per unit quantities.

UNIT - III

Symmetrical Fault Studies: Introduction to symmetrical fault analysis – short circuit capacity of a bus – the short circuit currents and the reactance of synchronous machines – internal voltages of loaded machines under transient conditions – expressions for fault MVA in terms of per unit and percentage quantities – need for current limiting reactors and their location.

UNIT - IV

Unsymmetrical Fault Studies: Symmetrical components – phase shift of symmetrical components in star-delta transformer banks – power in terms of symmetrical components – sequence impedances and sequence networks of synchronous machines, transmission lines, transformers – zero sequence networks of 3 Φ loads and 3 Φ transformer banks – unsymmetrical fault analysis on unloaded generator and on power systems with and without fault impedance.

UNIT - V

Load Flow Studies: Need for load flow studies in a power system – formation of bus admittance matrix – classification of types of buses in a power system – formulation of load flow equations – gauss-seidel iterative method for load flow studies – treatment of pv bus – acceleration factors – problems (sample one iteration only), newton - raphson method in rectangular and polar coordinates – formulation of load flow solution with or without pv buses – derivation of jacobian elements, algorithm and flowchart.

Text Books:

1. Elements of power system analysis, William. D. Stevenson, 4th Edition Jr., MGH
2. Modern Power System Analysis by I. J. Nagarath & D. P. Kothari, TMH, 2^{nd} Edition.
3. A Text Book on Power System Engineering by M. L. Soni, P. V. Gupta, U. S. Bhatnagar, Chakrabarti, Dhanpat Rai & Co Pvt. Ltd., 2003.

Reference Books:

1. Electrical power systems by C. L. Wadhwa, New Age International publications.
2. A course in Power Systems by J. B. Gupta, S. K. Kataria & Sons, 11th Edition, 2013.

Course Title	**Power Electronics**					**B.Tech V SEM EEE (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002503	**Professional Core (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration : 2Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to learn the basic concepts of power semiconductor devices, converters, choppers and inverters and their analysis.								
Course Outcomes: On successful completion of this course, the students will be able to,								
CO 1	Understand the basic operation of power semiconductor devices and passive components.							
CO 2	Analyze the performance of different power converters subjected to various loads.							
CO 3	Design static and dynamic equalizing circuits, Snubber circuits.							
CO 4	Evaluate the number of SCRs required for desired series /parallel operation, Electrical parameters and different variables of various power electronic circuits.							

<u>UNIT - I</u>

Silicon Controlled Rectifier: SCR – static characteristics –turn on and off mechanism – gate characteristics – dynamic characteristics – series and parallel operation of scr's – static and dynamic equalization circuits – design of snubber circuit – line commutation and forced commutation circuits, MOSFET, IGBT, GTO Characteristics.

<u>UNIT - II</u>

Phase controlled Rectifiers: Phase controlled rectifiers – single phase half and fully controlled converters – midpoint and bridge connections with R and RL loads – effect of source inductance- single phase and three phase half and fully controlled converters with R load - single phase and three phase dual converters with R and RL loads-numerical problems.

<u>UNIT - III</u>

AC Voltage Controllers: AC voltage controllers- single phase ac voltage controllers with SCR and triac for R and RL load –cyclo converters – single phase cyclo converters (mid-point and bridge configuration) with R and RL loads.

<u>UNIT - IV</u>

Choppers: Choppers – principle of operation – control strategies- types of chopper circuits – type A, type B, type C, type D and type E chopper circuits - multiphase chopper circuits – buck converter, boost converter, buck -boost converter, problems.

<u>UNIT - V</u>

Inverters: Inverters – single phase inverter – basic series inverter – basic parallel capacitor inverter – bridge inverter– current source inverter - forced commutation circuits for bridge inverters – output voltage control techniques- PWM techniques- space vector modulation - harmonic reduction techniques.

Text Books

1. Power Electronics – By M.D Singh & K.B. Kanchandhani, Tata McGraw Hill Publishing Company, 1998.
2. Power Electronics - Circuits, Devices and Applications – by M.H. Rashid, Prentice Hall of India, 2nd Edition 1998.
3. Power Electronics- by PS Bimbhra, Khanna Publications.

Reference Books

1. Power Electronics – By Vedam Subramanyam, New Age Information Limited, 3rd Edition.
2. Power Electronics – By V.R. Murthy, Oxford University Press, 1st Edition – 2005
3. Power Electronics – By P.C Sen, Tata Mc Graw Hill Publishing.
4. Thyristorised Power Controllers – By G.K. Dubey, S. R. Doradla, A. Joshi and R. M. K. Sinha, New Age Informational(p) Limited Publishing 1996.

<table>
<tr><td>Course Title</td><td colspan="5">Internet of Things (PEC- I)</td><td colspan="3">B.Tech V SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002504</td><td rowspan="2">Professional Elective Course
(PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the basic concepts of Internet of Things and its applications.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to:</td></tr>
<tr><td>CO 1</td><td colspan="8">Understanding IoT technology.</td></tr>
<tr><td>CO 2</td><td colspan="8">Learning basic IoT Elements.</td></tr>
<tr><td>CO 3</td><td colspan="8">Understanding basics of python programming.</td></tr>
<tr><td>CO 4</td><td colspan="8">Working with Arduino and Raspberry pi board.</td></tr>
</table>

UNIT-I

Introduction to Internet of Things: Definition and Characteristics of IoT, Physical Design of IoT-Things in IoT, IoT Protocols, Logic Design of IoT-Functional Blocks, Communication Models ,IoT Enabled Technologies-Wireless Sensor Networks, Communication protocols, Embedded Systems, IoT Levels and Templates.

UNIT-II

Elements of IoT: What is an IOT Device, Basic Building blocks of an IT Device, Sensors, Actuators, Details of Arduino-About Board Peripherals, Details of Raspberry Pi-About Board Peripherals.

UNIT-III

Logic Design: Introduction to Python, Python Data Types-Numbers, Strings ,Lists, Tuples, Dictionaries, Type Conversions, Control Flow, Functions, Modules.

UNIT-IV

IoT Application Development: Programming Arduino- Controlling LED, Interfacing an LED and Switch ,Interfacing a Light Sensor. Programming Raspberry Pi- Controlling LED, Interfacing an LED and Switch, Interfacing a Light Sensor.

UNIT-V

Case Studies of IoT: Smart Lighting, Smart Irrigation, Weather Monitoring System, Smart Parking

Text Books:

1. "INTERNET OF THINGS a Hand on Approach" by Arshdeep Bahga,Vijay Madisetti, Universities Press.
2. "Getting Started with the Internet of Things" by Cuno Pfister,o' REYLLY.

Course Title	Modern Control Theory (PEC - I)					B.Tech V SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002505	**Professional Elective Course (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration : 2Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: Students are able to learn the State Space, Describing function, phase plane and stability analysis including controllability and observability.								
Course Outcomes: On successful completion of this course, the students will be able to,								
CO 1	Understand the concept of state- State techniques.							
CO 2	Analyze the stability of linear and nonlinear Systems describing functions for different nonlinearities.							
CO 3	Construct the state model of linear time invariant systems and Liapunov functions for nonlinear systems.							
CO 4	Determine Eigen values state transition matrix examine the controllability and observability of linear time invariant systems.							
CO 5	Design compensators controllers state feedback controller and observer.							

UNIT – I

Linear System Design: Introduction of compensating networks – Lead, Lag, lead – lag cascade compensation in time domain –P, PI and PID controllers design using bode plot and root locus techniques.

UNIT – II

State variable descriptions: Concepts of state, state variables, state vector, state space model, representation in state variable form, phase variable representation – solution of state equations – state transition matrix.

UNIT – III

Controllability and Observability: Definition of controllability – controllability tests for continuous linear time invariant systems – Definition of observability – observability tests for continuous linear time invariant systems, Diagonalization – canonical variable representation.

UNIT – IV

Design of Control Systems: Introduction, Pole placement by state feedback, Full order and reduced order observers.

UNIT – V

Stability: Introduction, equilibrium points – stability concepts and definitions – stability in the sense of liapunov stability of linear system – methods of constructing liapunov functions for non – linear system – krasovskii’s method – variable gradient method.

Text Books

1. Modern Control System Theory by M. Gopal, New Age International Publishers, 2nd edition, 1996.

2. Control System Engineering by I. J. Nagarath and M. Gopal, New Age International (P) Ltd.

Reference Books

1. Modern Control Engineering by K. Ogata, Prentice Hall of India, 3rd Edition, 1998.
2. Systems and Control by Stainslaw, H. Zak, Oxford Press, 2003.
3. Digital Control and State Variable Methods by M. Gopal, TMH, 1997.

<table>
<tr><td>Course Title</td><td colspan="5">Energy Conversion Systems</td><td colspan="3">B.Tech V SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002506</td><td rowspan="2">Professional Elective Course
(PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn about energy conversion techniques, sources of electrical energy production and impact of energy conversion systems on the environment.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the principles and applications of various non-conventional energy systems and energy storage.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the properties and characteristics of wind, turbines and generators used in tidal power.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the solar cell operation and its test specifications.</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze the impact of energy conversion systems on the environment and remedial measures.</td></tr>
</table>

UNIT I

Photovoltaic Power Generation: Spectral distribution of energy in solar radiation, solar cell configurations, voltage developed by solar cell, photo current and load current, practical solar cell performance, test specifications for PV systems.

UNIT II

Wind Energy Conversion: Power from wind, properties of air and wind, types of wind Turbines, operating characteristics.

UNIT III

Tidal Power Station: Tides and tidal power stations, modes of operation, tidal project examples, turbines and generators for tidal power generation.
Ocean Energy Conversion: Types of ocean thermal energy conversion systems, Application of OTEC systems examples.

UNIT IV

Miscellaneous Energy Conversion Systems: biomass conversion, geothermal energy, thermoelectric energy conversion, principles of EMF generation, description of fuel cells**.** Types of fuel cells, H_2-O_2 Fuel cells, Application of fuel cells – Batteries, Description of batteries, Battery application for large power.

UNIT V

Environmental Effects: Environmental Effects of energy conversion systems, pollution from coal and preventive measures, steam stations and pollution, acid rain, pollution free energy systems and nuclear power station pollution.

Text Books

1. "Energy conversion systems" by Rakosh das Begamudre, New age international Private Ltd., publishers, 1st Edition, 2000.
2. "Renewable Energy Resources" by John Twidell and Tony Weir, CRC Press (Taylor & Francis).

Course Title	**Disaster Management**					**B.Tech CE V Sem (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE101	**Open Elective (OEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1.5 Hrs						**End Exam Duration: 3 Hrs**		

Course Objectives:

To make the student to provide basic conceptual understanding of disasters and its relationships with planning management.

To make the student to gain an understanding of the scope and extent to which natural and manmade disasters influence vulnerability profile of India.

To make the student able to relate disasters impact on social, economic and political environment.

To make the students to understand approaches of Disaster Risk Reduction and the relationship between vulnerability, disasters, disaster prevention and risk reduction.

To make the student able to enhance awareness of Disaster Risk Management and build skills to respond at disasters.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Define and describe the terminology used within disaster planning and Management.
CO 2	Understand the scope, extent, and complexity of natural and man-made disasters.
CO 3	Justify the knowledge gained from disaster impacts on health, psycho-social issues and demographic aspects
CO 4	Discuss effective means to plan, mitigate, respond, and recover from disasters and emergencies, natural and man-made
CO 5	Understand the problems associated with government collaboration and assistance to state and local governments and non-governmental organizations.

UNIT-I

Introduction

Concepts and definitions: disaster, hazard, vulnerability, risks severity, frequency and details, capacity, impact, prevention, mitigation.

UNIT – II

Disasters

Disasters classification; natural disasters: floods, draught, cyclones, volcanoes, earthquakes, tsunami, landslides, coastal erosion, soil erosion, forest fires etc.; manmade disasters: industrial pollution, artificial flooding in urban areas, nuclear radiation, chemical spills, transportation accidents, terrorist strikes, etc.; hazard and vulnerability profile of India, mountain and coastal areas, ecological fragility.

UNIT – III

Disaster Impacts

Disaster impacts (environmental, physical, social, ecological, economic, political, etc.); health, psycho-social issues; demographic aspects (gender, age, special needs); hazard locations; global and national disaster trends; climate change and urban disasters.

UNIT – IV

Disaster Risk Reduction (DRR)

Disaster management cycle – its phases; prevention, mitigation, preparedness, relief and recovery; structural and non-structural measures; risk analysis, vulnerability and capacity assessment; early warning systems, Post-disaster environmental response (water, sanitation, food safety, waste management, disease control, security, communications); sustainable and environmental friendly recovery; reconstruction and development methods.

UNIT – V

Environment and Development

Roles and responsibilities of government, community, local institutions, NGOs and other stakeholders; Policies and legislation for disaster risk reduction, DRR programmes in India and the activities of National Disaster Management Authority.

Text Books:

1. Pradeep Sahni and Madhavi Ariyabandu, "Disaster Risk Reduction in South Asia", PHI Learning Pvt. Ltd., Delhi.
2. B. K. Singh, "Handbook of Disaster Management: Techniques and Guidelines", Rajat Publications, Delhi.
3. Inter-Agency Standing Committee (IASC) (Feb. 2007). IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC.
4. Inter-Agency Standing Committee (IASC) (Feb. 2007) IASC Guidelines on Mental Health and Psychosocial Support in Emergency Settings. Geneva: IASC

Reference Books:

1. G. K. Ghosh, "Disaster Management", APH Publishing Corporation, New Delhi.
2. http://ndma.gov.in/ (Home page of National Disaster Management Authority.
3. http://www.ndmindia.nic.in/ (National Disaster management in India, Ministry of Home Affairs).
4. Disaster Medical Systems Guidelines. Emergency Medical Services Authority, State of California, EMSA no.214, June 2003.

<table>
<tr><td>Course Title</td><td colspan="5">Basics of Civil Engineering</td><td colspan="3">B.Tech CE V Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE102</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To include the essentials of civil engineering field to the students of all branches of Engineering
To provide the students an illustration of the significance of the civil engineering profession in satisfying social needs.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
</table>

CO 1	Illustrate the fundamental aspects of Civil Engineering.
CO 2	List the components of various types of buildings.
CO 3	Explain the concepts of planning and able to read a building plan.
CO 4	Illustrate the setting out of a building and acquire knowledge on building area items.
CO 5	Discuss about various building materials used for construction.

UNIT-I

General introduction to Civil Engineering

Various disciplines of civil engineering, Relevance of civil engineering in the overall infrastructural development of the country. Introduction to types of buildings as per NBC, selection of sites for buildings.

UNIT – II

Building Components

Components of residential buildings and their functions; Introduction to industrial buildings – office/factory/software development office/power house/electronic equipment service centre.

UNIT – III

Building planning

Introduction to planning of residential buildings- site plan, orientation of a building, open space requirement, position of doors and windows, size of rooms; preparation of a scaled sketch of the plan of a single storeyed residential building in a given site plan.

UNIT – IV

Building area items

Introduction to the various building area items – computation of plinth area / built up area, floor area / carpet area – for a single storeyed building; setting out of a building.

UNIT – V

Building construction

Foundations; Bearing capacity of soil (definition only) - Functions of foundations, Types - shallow and deep (sketches only)

Brick masonry – header and stretcher bond, English bonds – Elevation and Plan (one brick thick walls only)

Roofs – functions, types, roofing materials

Floors – functions, types; flooring materials

Paints and Painting – Purpose, types

Text Books:

1. Gopi, S., "Basic Civil Engineering", Pearson Publishers
2. S.S Bhavikatti, "Basics civil engineering", New international publishers
3. Rangwala, S.C and Dalal, K. B., "Building Construction", Charotar Publishing house
4. Rangwala, S.C., "Essentials of Civil Engineering", Charotar Publishing

Reference Books:

1. Mckay, W.B. and McKay, J. K., "Building Construction Volumes 1 to 4", Person India Education Services
2. Minu, S., "Basic Civil Engineering", Karunya Publication
3. Chudley, R., "Construction Technology, Vol. I to IV", Longman Group, England
4. Kandya, A. A., "Elements of Civil Engineering", Charotar Publishing house.

Course Title	Building Materials					B.Tech CE V Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20OE103	Open Elective (OEC)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 1.5 Hrs						End Exam Duration: 3 Hrs		

Course Objectives:

The importance and fundamental knowledge of building materials such as stones and aggregates its properties for better construction.
The laboratory, field tests conducted on Bricks and Cement to identify better construction materials with strength & durability.
The ability to understand the properties of Lime and Timber.
Understand various Masonry works used in the construction field.
To study the Modern Engineering materials used in construction.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Aware of natural and manufactured aggregates and the importance of physical properties of aggregates used for building construction.
CO 2	Identify various properties of bricks and steel used in construction of structures.
CO 3	Select appropriate timber and cement materials for different types of constructions.
CO 4	Choose suitable masonry works for modern construction to enhance the elegance and performance.
CO 5	Aware of different modern materials in construction.

UNIT-I

Stones and Aggregates

Properties of building stones – Classification of stones – Stone quarrying, precautions in blasting – Dressing of stone, Fine aggregate: Natural and manufactured – Sieve analysis – Different tests on fine aggregate, Coarse aggregate: Natural and manufactured – Importance of size, shape and texture.

UNIT – II

Bricks

Composition – Types of bricks – Manufacturing process of bricks – Test on bricks – Standard requirements and grades.

Steel

Types and grades of steel, tests on steel, applications.

UNIT – III

Cement

Introduction – Chemical Composition – Types of cement with their specific uses – Grade of cement as per BIS – Engineering properties of cement – Field and Laboratory test of cement as per BIS.

Timber

Types of timber – Uses and application of timber – Defects in timber and wood – Seasoning Wood – Wood products with specific uses

UNIT – IV

Masonry Works

Masonry - Stone Masonry - Rubble Masonry - Brick Masonry - Bond - Types of bonds - English and Flemish bonds - Composite masonry - Concrete Masonry - Reinforced masonry - Types of walls - Types of Partition walls.

UNIT – V

Modern Building Materials

Aluminum – Fiber Reinforced Polymers – Ferro cement – Composite materials – Light Weight Roofing Materials – GI Sheets – Ceramics – Other Modern Materials.

Text Books:

1. Rajput R.K. “Engineering Materials”, S. Chand & Company Ltd. New Delhi, Third Edition2009.
2. P C Varghese, “Building Materials”, PHI Learning Pvt. Ltd., Delhi.
3. G C Sahu, Joygopal Jena, “Building Materials and Construction”, McGraw hill Pvt Ltd 2015.
4. Arthur Lyons De, “Materials for Architects and Builders”, Montfort University, Leicester, UK.

Reference Books:

1. S C Rangwala, “Engineering Materials”, Charotar Publishing House Pvt. Ltd., Anand, Gujarat.
2. S K Duggal, “Building Materials”, New Age International (P) Limited, Publishers, New Delhi.
3. S. C. Rangwala, “Building Construction”, Charotar Publishing House Pvt. Ltd., Anand, Gujarat.
4. R. Chubby, “Construction Technology – Vol – I & II”, Longman UK

<table>
<tr><td>Course Title</td><td colspan="4">Introduction to Hybrid and Electrical Vehicles</td><td colspan="3">B.Tech ME V Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE301</td><td rowspan="2">OEC-I</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:
. The objectives of this course are to
Provide good foundation on hybrid and electrical vehicles.
To address the underlying concepts and methods behind power transmission in hybrid and electrical vehicles.
Familiarize energy storage systems for electrical and hybrid transportation.
To design and develop basic schemes of electric vehicles and hybrid electric vehicles.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Use working of hybrid and electric vehicles.
CO 2	Choose a suitable drive scheme for developing an hybrid and electric vehicles depending on resources.
CO 3	Develop the electric propulsion UNIT and its control for application of electric vehicles
CO 4	Choose proper energy storage systems for vehicle applications.
CO 5	Design and develop basic schemes of electric vehicles and hybrid electric vehicles.

UNIT – I
Electric Vehicle Propulsion And Energy Sources
Introduction to electric vehicles, vehicle mechanics - kinetics and dynamics, roadway fundamentals propulsion system design - force velocity characteristics, calculation of tractive power and energy required, electric vehicle power source - battery capacity, state of charge and discharge , specific energy, specific power, Ragone plot. battery modeling - run time battery model, first principle model, battery management system- soc measurement, battery cell balancing. Traction batteries - nickel metal hydride battery, Li-Ion, Lipolymer battery.

UNIT – II
Electric Vehicle Power Plant And Drives
Introduction electric vehicle power plants. Induction machines, permanent magnet machines, switch reluctance machines. Power electronic converters-DC/DC converters - buck boost converter, isolated DC/DC converter. Two quadrant chopper and switching modes. AC drives- PWM, current control method. Switch reluctance machine drives - voltage control, current control.

UNIT – III
Hybrid And Electric Drive Trains
Introduction hybrid electric vehicles, history and social importance, impact of modern drive trains in energy supplies.Hybrid traction and electric traction. Hybrid and electric drive train topologies. Power flow control and energy efficiency analysis, configuration and control of DC motor drives and induction motor drives, permanent magnet motor drives, switch reluctance motor drives, drive system efficiency.

UNIT - IV
Electric And Hybrid Vehicles - Case Studies
Parallel hybrid, series hybrid -charge sustaining, charge depleting.Hybrid vehicle case study – Toyota Prius, Honda Insight, Chevrolet Volt. 42 V system for traction applications. Lightly hybridized vehicles and low voltage systems. Electric vehicle case study - GM EV1, Nissan

Leaf, Mitsubishi Miev.Hybrid electric heavy duty vehicles, fuel cell heavy duty vehicles.

<u>UNIT – V</u>

Electric And Hybrid Vehicle Design

Introduction to hybrid vehicle design.Matching the electric machine and the internal combustion engine. Sizing of propulsion motor, power electronics, drive system. Selection of energy storage technology, communications, supporting subsystem.Energy management strategies in hybrid and electric vehicles - energy management strategies- classification, comparison, implementation.

<u>Text Books:</u>

1. Iqbal Hussein, Electric and Hybrid Vehicles: Design Fundamentals, 2/e, CRC Press, 2003.
2. Amir Khajepour, M. Saber Fallah, AvestaGoodarzi, Electric and Hybrid Vehicles: Technologies, Modeling and Control - A Mechatronic Approach, illustrated edition, John Wiley & Sons, 2014.
3. MehrdadEhsani, YimiGao, Sebastian E. Gay, Ali Emadi, Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design, CRC Press, 2004.

<u>Reference Books:</u>

1. James Larminie, John Lowry, Electric Vehicle Technology Explained, Wiley, 2003.
2. Drives for Hybrid, Electric and Fuel Cell Vehicles, 1/e, Wiley-Blackwell, 2018

<table>
<tr><td>Course Title</td><td colspan="4">Rapid Prototyping</td><td colspan="3">B. Tech. ME V Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE302</td><td rowspan="2">OEC-I</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
. The objectives of this course are to
Familiarize techniques for processing of CAD models for rapid prototyping.
Explain fundamentals of rapid prototyping techniques.
Demonstrate appropriate tooling for rapid prototyping process.
Focus Rapid prototyping techniques for reverse engineering.
Train Various Pre – Processing, Processing and Post Processing errors in RP Processes</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Use techniques for processing of CAD models for rapid prototyping.</td></tr>
<tr><td>CO 2</td><td colspan="8">Implement fundamentals of rapid prototyping techniques.</td></tr>
<tr><td>CO 3</td><td colspan="8">Choose appropriate tooling for rapid prototyping process.</td></tr>
<tr><td>CO 4</td><td colspan="8">Create rapid prototyping techniques for reverse engineering.</td></tr>
<tr><td>CO 5</td><td colspan="8">Identify Various Pre – Processing, Processing and Post Processing errors in RP processes.</td></tr>
</table>

UNIT - I

Introduction to RP Introduction

Introduction to Prototyping, Traditional Prototyping Vs. Rapid Prototyping (RP), Need for time compression in product development, Usage of RP parts, Generic RP process, Distinction between RP and CNC, other related technologies, Classification of RP.

RP Software: Need for RP software, MIMICS, Magics, SurgiGuide, 3-matic, 3D-Doctor, Simplant, Velocity2, VoXim, SolidView, 3DView, etc., software, Preparation of CAD models, Problems with STL files, STL file manipulation, RP data formats: SLC, CLI, RPI, LEAF, IGES, HP/GL, CT, STEP.

UNIT - II

Solid and Liquid Based RP Systems

Solid and Liquid Based RP Systems: Stereolithography (SLA): Principle, Process, Materials, Advantages, Limitations and Applications. Solid Ground Curing (SGC): Principle, Process, Materials, Advantages, Limitations, Applications. Fusion Deposition Modeling (FDM): Principle, Process, Materials, Advantages, Limitations, Applications. Laminated Object Manufacturing (LOM): Principle, Process, Materials, Advantages, Limitations, Applications.

UNIT - III

Powder Based RP Systems Powder Based RP Systems

Principle and Process of Selective Laser Sintering (SLS), Advantages, Limitations and Applications of SLS, Principle and Process of Laser Engineered Net Shaping (LENS), Advantages, Limitations and Applications of LENS, Principle and Process of Electron Beam Melting (EBM), Advantages, Limitations and Applications of EBM.

Other RP Systems: Three Dimensional Printing (3DP): Principle, Process, Advantages, Limitations and Applications. Ballastic Particle Manufacturing (BPM): Principle, Process, Advantages, Limitations, Applications. Shape Deposition Manufacturing (SDM): Principle, Process, Advantages, Limitations, Applications.

UNIT - IV

Rapid Tooling

Rapid Tooling: Conventional Tooling Vs. Rapid Tooling, Classification of Rapid Tooling, Direct and Indirect Tooling Methods, Soft and Hard Tooling methods.

Reverse Engineering (RE): Meaning, Use, RE – The Generic Process, Phases of RE Scanning, Contact Scanners and Noncontact Scanners, Point Processing, Application Geometric Model, Development.

UNIT – V

Errors in RP Processes

Errors in RP Processes: Pre-processing, processing, post-processing errors, Part building errors in SLA, SLS, etc.

RP Applications: Design, Engineering Analysis and planning applications, Rapid Tooling, Reverse Engineering, Medical Applications of RP.

Text Books:

1. Chee Kai Chua and Kah Fai Leong, “3D Printing and Additive Manufacturing Principles and Applications” Fifth Edition, World Scientific Publications, 2017.
2. Ian Gibson, David W Rosen, Brent Stucker, “Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing”, Springer, Second Edition, 2010.

Reference Books:

1. Frank W.Liou, “Rapid Prototyping & Engineering Applications”, CRC Press, Taylor & Francis Group, 2011.

<table>
<tr><td>Course Title</td><td colspan="4">Design for Manufacturing and Assembly</td><td colspan="3">B.Tech ME V Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE303</td><td rowspan="2">OEC-I</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
. The objectives of this course are to
Discuss various factors influencing the manufacturability of components and use of tolerance s in manufacturing
Explain various considerations in casting, welding, forging and machining processes.
Demonstrate on the design factors dependent on the assembly methods.
Teach the principles and rules of design for assembly.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Apply the importance of Design for Manufacturing and Assembly.</td></tr>
<tr><td>CO 2</td><td colspan="8">Examine the form design factors with the help of Case study.</td></tr>
<tr><td>CO 3</td><td colspan="8">Evaluate how the factor of redesign affects the product life cycle.</td></tr>
<tr><td>CO 4</td><td colspan="8">Make use of DFA methods proposed by Boothroyd and Dewhurst.</td></tr>
<tr><td>CO 5</td><td colspan="8">Analyse the importance of Design for Manufacturing and Assembly.</td></tr>
</table>

UNIT - I

Introduction to DFM

Significance of design, qualities of a designer and Design factors, Systematic working plan, The engineering problem to be solved, The basic design, Factors influencing choice of materials and the factors influencing manufacturing Process Capability Mean, Median, Variance, Mode, Standard Deviation, Normal Distribution and Process capability metrics, Process Capability, Tolerances-symbols and definition, Tolerances relevant to manufacturing, assembly and material condition, Tolerance stack- effects on assembly with examples, Methods of eliminating tolerance stack with examples.

UNIT - II

Form Design-Casting and Welding

Influence of loading, Materials, Production methods on form design, Casting considerations, Grey iron castings, Steel castings, Aluminum Casting Requirements and rules for casting, Form design of pressure die castings, Welding considerations welding Processes, Requirements and rules for welding, Redesign of components for casting-pattern-mould-Parting Line, Redesign of components for welding, Case studies in form design-simple problems in form design

UNIT – III

Form Design-Forging and Machining

Forging considerations hammer forging drop forging, Requirements and rules for forging, Choice between casting, forging and welding, Machining considerations Drills, Milling-Keyways, Dwells and Dwelling Procedure Countersunk Head screws Requirements and rules for Machining considerations and Reduction of machined areas Redesign of components for Forging, Redesign of components for Machining, Simplification by separation and Simplification by amalgamation, Case studies.

UNIT - IV

Introduction to DFA

DFA, Introduction, Distinction between assembly methods and processes, Factors Determining assembly methods and processes, Success and failure-Causes of failure, Product Design factors independent of methods and processes , Introduction-Number of operations in the product, Assembly Precedence, Standardization, Design factors dependent on Assembly methods , Introduction-Single Station Assembly Line Assembly, Hybrid Systems, Manual Assembly lines, Flexible Assembly lines, Design factors dependent on Assembly processes, Factors Influencing Production rate to Facility Ratio- Parts Presentation, Manual Assembly, Dedicated Assembly, Transportation, Separation and Orientation-Flexible Assembly, Gripping, Transferring, Part Insertion, Failures and Error Recovery.

UNIT - V

Design For Assembly Methods

Approaches to design for assembly and Introduction, Approaches based on design principles and rules, Example DFA method using Design Principles, DFA Systems employing Quantitative evaluation procedures, IPA Stuttgart Method, DFA Methods employing a Knowledge based approach, Knowledge representation Computer Aided DFA methods, Part model, Feature, Processing. Assembly measures like Qualitative and Quantitative measures, Boothroyd and Dewhurst DFA method. Redesign of a simple product , Small consumer product and Fastener solution redesign using symmetry, Case Studies Designing of a disposal valve, Design of a lever-arch file mechanism.

Text Books:

1. Harry Peck., “Design for Manufacture”, Pittman Publications, 1983.
2. Alan Redford and chal, “Design for Assembly-Principles and Procedures”, McGraw Hill International Europe, London, 1994.

Reference Books:

1. RobertMatousek, “Engineering Design A Systematic Approach”, Blackie &sons Ltd., 1963.
2. James G.Bralla, “Hand Book of Product design for Manufacturing”, McGraw Hill Co., 1986.
3. Swift, K.G., “Knowledge Based Design for Manufacture”, Kogan Page Ltd., 1987

<table>
<tr><td>Course Title</td><td colspan="4">Energy Systems in Engineering</td><td colspan="3">B.Tech ME V Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE304</td><td rowspan="2">OEC-I</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
. The students completing this course are expected:
Familiarize the sources of energy, power plant economics and environmental aspects.
Outline the working components of different power plant.
Explain renewable energy sources; characteristics, working principle, classify types, layouts, and plant operations.
Impart types of nuclear power plants, and outline working principle and advantages and hazards.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Describe working components of a steam power plant.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand the various elements of hydroelectric power plant and their types.</td></tr>
<tr><td>CO 3</td><td colspan="8">Illustrate the working mechanism of Nuclear and Gas turbine power plants.</td></tr>
<tr><td>CO 4</td><td colspan="8">Summarize types of renewable energy sources and their working principle.</td></tr>
<tr><td>CO 5</td><td colspan="8">Analize power plant economics, and environmental aspects.</td></tr>
</table>

UNIT – I

Introduction to different Sources of Energy.

STEAM POWER PLANT: Layout of Modern Steam Power Plant, working of different circuits-selection of site- Coal Storage- Classification of coal handling and Ash handling systems.

UNIT – II

HYDRO ELECTRIC POWER PLANT: Selection of Site for Hydro Electric Power Plant – Hydrological cycle – Hydrographs - flow duration curve - mass curve – classification of dams, spill ways and surge tanks.

HYDRO PROJECTS AND PLANT: Classification of Hydro Electric Power Plants – Typical layout – plant auxiliaries – plant operation - pumped storage plants.

UNIT – III

NUCLEAR POWER PLANT: Nuclear fuel – breeding and fertile materials – Nuclear reactor –reactor operation.

TYPES OF REACTORS: Pressurized Water Reactor, Boiling Water Reactor, Sodium-Graphite Reactor, Fast Breeder Reactor, Homogeneous Reactor and Gas Cooled Reactor - Radiation hazards and shielding –radioactive waste disposal.

GAS TURBINE POWER PLANT: Introduction – Plant Layout – Classification – Working of Simple Gas Turbine Power Plant– Constant pressure and constant volume Gas Turbine Power Plants –Combination of GasTurbine Cycles.

UNIT- IV

POWER FROM NON-CONVENTIONAL SOURCES: Utilization of Solar- Collectors-Principle
of Working, Wind Energy– types – HAWT, VAWT -Tidal Energy.

Direct energy conversion: Solar energy, Fuel cells, MHD generation.

UNIT – V

POWER PLANT ECONOMICS: Definitions of connected load, Maximum demand, demand factor, average load, load factor, diversity factor, utilization factor, Plant capacity factor and plant use factor - Types of loads **-**Load curve and load duration curve **-** general arrangement of power distribution

Different types of tariff for Electrical energy –Cost of generation and fixed cost, semi fixed cost, running cost, depreciation methods, and straight line methods Simple problems.

Text Books:

1. P.K. Nag, Power Plant Engineering, 3/e, TMH, 2013.
2. Arora and S. Domkundwar, A course in Power Plant Engineering, DhanpatRai& Co (P) Ltd, 2014

Reference Books:

1. Rajput, A Text Book of Power Plant Engineering, 4/e, Laxmi Publications, 2012.
2. Ramalingam, Power plant Engineering, Scietech Publishers, 2013
3. P.C. Sharma, Power Plant Engineering, S.K. Kataria Publications, 2012

Course Title	**Smart Materials**					**B.Tech ME V Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE305	**OEC-I**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:

. The objectives of this course are to

Introduce the students with HBLS and LBHS smart materials.

Expose the students in smart systems development and uses.

Understand the working principle of smart actuators and smart sensors.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Analyse the role of smart materials in development of intelligent systems and adaptive structures.
CO 2	Compare polycrystalline and single crystal piezoelectric materials
CO 3	Identify the influence of stress on characteristic temperatures in SMA and EAP
CO4	Evaluate the role of smart materials in development of intelligent systems and adaptive structures.
CO 5	Develop of various sensors.

UNIT - I

Introduction to Smart Materials

Introduction to Smart Materials: What is Intelligence? Artificial intelligence Vs. embedded Intelligence, Definition of smart material, need for smart materials, classifications of smart systems, components of a smart systems, smart system applications, the role of Smart Materials in developing Intelligent Systems and Adaptive Structures.

UNIT - II

High bandwidth - Low strain generating (HBLS) Smart Materials

Piezoelectric Materials – constitutive relationship, electromechanical coupling coefficients, piezoelectric constants, piezoceramic materials, variation of coupling coefficients in hard and soft piezoceramics, polycrystalline vs single crystal piezoelectric materials, polyvinyldene fluoride, piezoelectric composites.

Magnetostrictive Materials – constitutive relationship, magneto-mechanical coupling coefficients, Joule Effect, Villari Effect, Matteuci Effect, Wiedemann effect, Giant magnetostriction in Terfenol-D, Terfenol-D particulate composites, Galfenol and Metglas materials.

UNIT - III

Low bandwidth - High strain generating (LBHS) materials

Low bandwidth - High strain generating (LBHS) materials: Shape Memory Alloys (SMA) – Introduction, Phenomenology, Influence of stress on characteristic temperatures, Modelling of shape memory effect. Vibration control through shape memory alloys. Design considerations, multiplexing embedded NiTiNOL actuators. Electro-active Polymers (EAP)- Introduction, Phenomenology, Influence of stress on characteristic temperatures.

UNIT - IV

Smart actuators

Based on HBLS smart materials: Piezoelectric Actuators – Induced Strain actuation model, Unimorph and Bimorph Actuators, Actuators embedded in composite laminate, Impedance

matching in actuator design, Feedback Control, Pulse Drive, Resonance Drive.
Magnetostrictive Actuators – Magnetostrictive Mini Actuators, Thermal instabilities, Discretely distributed actuation, Manetostrictive Composites.
Based on LBHS Smart Materials - Shape Memory Alloy based actuators for Shape Control, Electro-active Polymers for Work-Volume Generation.

UNIT - V

Smart sensors:
Sensors based on HBLS Smart Materials - Piezoelectric Sensors Magnetostrictive Sensors Techniques of Self Sensing MEMS Sensors.
Sensors based on LBHS Smart Materials - EAP based sensors, SMA based encoders, Optical Fibre based Sensing.

Text Books:

1. M.V. Gandhi, B.D. Thompson" Smart Materials and Structures" Springer Science & Business Media, 31-May-1992.

Reference Books:

1. Brian Culshaw, Smart Structures and Materials, Artech House, 2000.
2. Gauenzi, P., Smart Structures, Wiley, 2009.

<table>
<tr><td>Course Title</td><td colspan="5">Overview of Microcontrollers</td><td colspan="3">Open Electives</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE401</td><td rowspan="2">OE</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To become familiar with 8051, MSP 430, PIC and ARM controllers.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
</table>

CO 1	Understand the types of Microcontrollers.
CO 2	Define various components and list out various features of microcontrollers.
CO 3	Describe the various blocks of 8051, MSP 430, PIC and ARM microcontrollers

UNIT I

Introduction: Microcontrollers, Vonneumann Vs Harvard, CISC vs RISC, Types of Microcontrollers, Examples of Microcontrollers, Selection of a microcontroller, Microcontroller resources, Applications.

UNIT II

The 8051 Architecture: Introduction, architecture of 8051, pin diagram, internal RAM memory organization, Special Function Registers, external memory interfacing-ROM & RAM, stack, timers and interrupts.

UNIT III

MSP 430 Microcontroller: The Outside View—Pin-Out, The Inside View—Functional Block Diagram, Memory, Central Processing Unit, Memory-Mapped Input and Output, Clock Generator, Exceptions: Interrupts and Resets.

UNIT IV

PIC Microcontrollers: Overview and Features, Architecture Details of PIC 16C6X/7X, I/O Ports, Interrupts, Timer, ADC, Features of 16F8XX series.

UNIT V

ARM Architecture: RISC Design philosophy, ARM Design philosophy, Registers, Program Status Register, Instruction pipeline, Interrupts and vector table.

Text Books:

1. Raj Kamal, “Microcontrollers **-** Architecture, Programming, Interfacing and System Design”- Second Edition, Pearson, 2012.
2. John H Davis, “MSP 430 Microcontroller Basics”, Newnes publishers, 2008.
3. Andrew N.Sloss, Dominic Symes, Chris Wright “ARM System Developer’s Guide-Designing and Optimizing system software”, Elsevier, 2008.
4. Ajay V Deshmukh, “Microcontrollers: Theory and Applications”, TMH, 2005.

Reference Books:

1. Mazidi Muhammad Ali, Mazidi Janice Gillespie &McKinlayRolin D, *The 8051Microcontroller and Embedded Systems*, 2nd Edition, Pearson Education, 2008.
2. Design with PIC Microcontrollers – John B. Peatman, Pearson Education, 2005.

<table>
<tr><td>Course Title</td><td colspan="5">Industrial electronics</td><td colspan="3">Open Electives</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE402</td><td rowspan="2">OE</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To understand working of semiconductor devices.
To gain the knowledge of AC to DC, AC to AC and DC to DC converters.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the basics of Power Electronics.</td></tr>
<tr><td>CO 2</td><td colspan="8">Learn the details of power semiconductor switches (Construction, Characteristics and operation)</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand the working of various types of converters.</td></tr>
<tr><td>CO 4</td><td colspan="8">Learn how to analyze the converters and design the components of them, under various load types.</td></tr>
<tr><td>CO 5</td><td colspan="8">Learn about the control of various converters</td></tr>
</table>

Unit-I

Power Semiconductor devices: Constructional features, Operating Principle, Characteristics and specification of power semiconductor diode, Power Bipolar Junction transistor (BJT), Thyristors and Triacs, Gate Turn off Thyristors (GTO), Metal oxide semiconductor field effect transistor (MOSFET), Insulate Gate Bipolar transistor (IGBT), Hard and soft switching of Power semiconductors.

Unit-II

AC to DC Convertors: Single Phase uncontrolled rectifier, Single Phase fully controlled rectifier, single phase half controlled bridge rectifier, Operation and analysis of three phase fully controlled bridge converter, Operation and analysis of three phase half controlled converter, Effect of source Inductance on the performance of AC to DC converters, Power factor improvement, Harmonic reduction, filter.

Unit-III

DC to DC Converters: Types of basic DC-DC converters, Analysis of Buck converter (DC-DC) circuit, Commutation of thyristor based circuits, Introduction to switched mode power supply (SMPS) circuits, Fly-back type switched mode power supply, Forward type switched mode power supply, Design of transformer for switched mode power supply circuits.

Unit-IV

AC to AC Voltage converter: Three phase AC regulators, Phase angle control in Traic based single Phase AC regulators, Introduction to cyclo converters, three phases to single phase cyclo converters, three phase to three phase cyclo converters, Control circuit for three phase to three phase converter.

Unit-V

Introduction to voltage source Inverters, Analysis of 1-Phase square wave voltage source Inverter, 3-Phase voltage source with square wave output. 3-phase pulse width modulated inverter. Sine PWM and its realization, current source Inverter, Load commutated current source inverter.

Text Books:

1. M. D. Singh and K. B. Khanchandani," Power Electronics".
2. Ned Mohan, Tore M. Undeland, and William P. Robbins,"Power Electronics: Converters, Applications And Design, Media Enhanced (With CD)".
3. John G. Kassakian, Martin F. Schlecht, and George C. Verghese,"Principles Of Power Electronics".

Reference Books:

1. G. K. Mithal , Maneesha Gupta, "Industrial and Power Electronics", Khanna Publishers,1987.
2. George M. Chute, R. D. Chute, "Electronics in Industry", McGraw-Hill School Pub Co, 5th Edition

<table>
<tr><td>Course Title</td><td colspan="6">Data Structures
(Open Elective Course I)</td><td colspan="3">B.Tech V Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="4">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE501</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td colspan="2">Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td colspan="2">40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="5">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="10">Course Objectives:
To develop skills and analyze linear and nonlinear data structures.
To understand basic concepts about linked lists, stacks, queues.
To study algorithms as they apply to trees and graphs.
To study in detail about sorting.</td></tr>
<tr><td colspan="10">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="9">Understand the variety of abstract data types and data structures.</td></tr>
<tr><td>CO 2</td><td colspan="9">Analyze data structures such as linked list, Stacks and Queues.</td></tr>
<tr><td>CO 3</td><td colspan="9">Apply and analyze tree traversal algorithms and graph traversal algorithms.</td></tr>
<tr><td>CO 4</td><td colspan="9">Organize data in order using various sorting algorithms.</td></tr>
</table>

UNIT - I

Introduction: Data structures, Primitive & Non Primitive data structures, Linear & Non Linear data structures, **Linear Lists:** Definition, **Arrays:** Definition, **Linked Lists:** Single Linked List-Definition, Insertion and Deletion operations**,** Doubly Linked List- Definition, Insertion and Deletion operations. **Stacks:** Definition, Array & Linked representations, Operations, Applications.

UNIT – II

Queues: Definition, Array & Linked representations, Operations, Circular Queues & Dequeues.

Trees: Basic terminology, **Binary Trees** - Definition, Properties, Representation, Complete and Full Binary Tree, **Tree Traversal Algorithm:** Inorder, Preorder and Postorder.

UNIT – III

Binary Search Tree (BST): Definition, Operations & Implementations, Indexed BST.
Balanced Search Trees: AVL trees, Red-Black trees & Splay trees.

UNIT - IV

Graphs: Terminology, Representations, **Graph Traversal:** Depth First Search (DFS), Breadth First Search (BFS), Applications of graphs.

UNIT - V

Sorting: Selection, Insertion, Bubble, Heap, Quick Sort, Merge Sort.
Searching: Linear and Binary search.
Hashing: Introduction, Hash Table representation, Hash Functions.

Text Books:

1. An Introduction to Data Structures with applications, Jean Paul Trembley and Paul G.Sorenson, McGraw Hill.

2. Fundamentals of Data Structures in C, Horowitz, Sahni, Anderson Freed, Universities press.
3. Data Structures using C++, Varsha H.Patil, Oxford University Press.
4. Data Structures, Seymour Lipschutz, Schaum's Outlines, McGraw Hill.
5. Data Structures and Algorithms, G.A.V.Pai, Tata McGraw Hill.

Reference Books:

1. Data Structures, Algorithms and Applications in C++, AnandaRao Akepogu and Radhika Raju Palagiri, Pearson Education.
2. Data Structures and Algorithms in C++, S.Sahni, University Press (India) Private Limited, Second Edition.
3. Data Structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.

<table>
<tr><td>Course Title</td><td colspan="4">Database Management Systems
(Open Elective Course – I)</td><td colspan="4">B.Tech V Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE502</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam s</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To study the physical and logical database designs, database modeling, relational hierarchical, and network models.
To understand and use data manipulation language to query, update, and managing the database.
To develop an understanding of essential DBMS concepts such as: database secur integrity and concurrency.</td></tr>
</table>

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	To understand the basic concepts and the application of Database systems.
CO 2	To understand the basics of SQL and construct queries using SQL.
CO 3	To understand the Relational Database design principles.
CO 4	To apply various Normalization techniques for database design improvement.
CO 5	To apply concurrency control and recovery techniques during transactionexecution.

UNIT-I

Introduction - Database-System Applications, View of Data, Database languages, Database architecture, Database Users and Administrators.

E-R Model - The Entity Relationship Model, Constraints, Entity Relationship Diagrams, and Extended E-R features.

UNIT-II

Relational Model - Structure of Relational Databases, Database Schema, Keys, Query Languages, Fundamental Relational Algebra Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations, Modification of Database.

UNIT-III

Introduction to SQL - Data Definition, Basic Structure of SQL Queries, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Complex queries, views, Modification of the Database.

Advanced SQL -Integrity Constraints, Dynamic SQL, Functions and Procedures.

Other Relational Query Languages - Tuple Relational Calculus, Domain Relational calculus.

UNIT-IV

Normal Forms – Atomic domain and First Normal Form, Keys and Functional Dependencies, Second Normal Form, BCNF, BCNF and Dependency Preservation, Third Normal Form, Lossless Decomposition, Dependency- preserving, Multi valued Dependencies, Fourth Normal Form, Join Dependencies, Fifth Normal Form, and Inclusion dependencies.

UNIT-V

Transactions -Transaction Concept, Transaction State, Implementation of Transaction Atomicity and Durability, Concurrent Executions, Serializability.

Concurrency Control -Lock-Based Protocols, Timestamp-Based Protocols. **Recovery System -** Failure Classification, Storage, Recovery and Atomicity, Log based recovery.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan, ”Database system Concepts”, 5^{th}Edition, McGrawhill.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 3rd Edition, 2003
3. C.J.Date, “Introduction to Database”, 8 Th Edition, 2003, Addison-Wesley publication.
4. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States 1st Edition, 2000

Reference Books:

1. Raghurama Krishnan, Johannes Gehrke, Data base Management Systems.3^{rd}
2. Edition, Tata McGrawHill.
3. Peter Rob, Ananda Rao and Carlos Corone, Database Management Systems,
4. Cengage Learning, 1^{st} Edition, 2011
5. Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design,
6. Implementation and Management,6th Edition,2012.
7. S.K.Singh, “Database Systems Concepts, Design and Applications”, First Edition, Pearson Education, 2006.

Course Title	**DATA STRUCTURES (Open Elective Course – I)**				**B.Tech. V Sem (R20UG) AI&ML**			
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
20OE3901	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:
To develop skills and analyze linear and nonlinear data structures.
To understand basic concepts about linked lists, stacks, queues.
To study algorithms as they apply to trees and graphs.
To study in detail about sorting.

Course Outcomes: On successful completion of this course, the students will be able to	
CO1	Understand the variety of abstract data types and data structures.
CO2	Analyze data structures such as linked list, Stacks and Queues.
CO3	Apply and analyze tree traversal algorithms and graph traversal algorithms.
CO4	Organize data in order using various sorting algorithms.

UNIT - I
Introduction: Data structures, Primitive & Non Primitive data structures, Linear & Non Linear data structures, **Linear Lists:** Definition, **Arrays:** Definition, **Linked Lists:** Single Linked List-Definition, Insertion and Deletion operations**,** Doubly Linked List- Definition, Insertion and Deletion operations. **Stacks:** Definition, Array & Linked representations, Operations, Applications.

UNIT – II
Queues: Definition, Array & Linked representations, Operations, Circular Queues & Dequeues.
Trees: Basic terminology, **Binary Trees** - Definition, Properties, Representation, Complete and Full Binary Tree, **Tree Traversal Algorithm:** In order, Preorder and Post order.

UNIT – III
Binary Search Tree (BST): Definition, Operations& Implementations, Indexed BST.
Balanced Search Trees: AVL trees, Red-Black trees & Splay trees.

UNIT - IV
Graphs: Terminology, Representations, **Graph Traversal:** Depth First Search (DFS), Breadth First Search (BFS), Applications of graphs.

UNIT - V
Sorting: Selection, Insertion, Bubble, Heap, Quick Sort, Merge Sort.
Searching: Linear and Binary search.
Hashing: Introduction, Hash Table representation, Hash Functions.

Text Books:

1. An Introduction to Data Structures with applications, Jean Paul Trembley and Paul G.Sorenson, McGraw Hill.
2. Fundamentals of Data Structures in C, Horowitz, Sahni, Anderson Freed, Universitiespress.
3. Data Structures using C++, Varsha H.Patil, Oxford University Press.
4. Data Structures, Seymour Lipschutz, Schaum's Outlines, McGraw Hill.
5. Data Structures and Algorithms, G.A.V.Pai, Tata McGraw Hill.

Reference Books:

1. Data Structures, Algorithms and Applications in C++, AnandaRao Akepogu and Radhika Raju Palagiri, Pearson Education.
2. Data Structures and Algorithms in C++, S.Sahni, University Press (India) Private Limited,Second Edition.
3. Data Structures using C and C++, Langsam, Augenstein and Tanenbaum, PHI.

Course Title	OOP THROUGH C++ (Open Elective Course – I)					B.Tech. V Sem (R20UG) AI&ML		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
20OE3902	**PJ**	**L**	**T**	**P**	**C**	**ContinuousInternal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:
To make the students understand the features of object-oriented design and familiarizethem with virtual functions, templates and exception handling.
To enable the students solve various engineering problems in C++ programminglanguage.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the fundamentals of C++
CO 2	Explain the concept of Tokens and Control Structures.
CO 3	Illustrate the concept of Classes and Objects.
CO 4	Demonstrate the concept of Operator overloading and Inheritance.
CO 5	Understand the concept of Pointers, Virtual functions and Polymorphism

UNIT – I

Principles of Object-Oriented Programming: Object-Oriented Programming Paradigm, Basic Concepts of Object-Oriented Programming, Benefits of OOP, Applications of OOP. **Beginning with C++:** Comments, Output Operator, The iostream File, Variables, Input Operator, Cascading of I/O Operators, Structure of C++ program.

UNIT – II

Tokens, Expressions and Control Structures: Tokens, Keywords, Identifiers and Constants, Basic Data Types, Declaration of variables, Dynamic initialization of variables, Reference variables, Operators in C++, Scope resolution operator, Memory management operators, Manipulators, Control Structures,
Functions in C++: Function Prototyping, Call by reference, Return by reference, Inline Functions, Function Overloading.

UNIT – III

Classes and Objects: Specifying a Class, Defining Member Functions, Memory allocation for objects, Static data members, Static member functions, Arrays of objects, Friendly functions, **Constructors and Destructors:** Constructors, Parameterized constructors, Multiple constructors in aclass, Constructors with default arguments, Copy constructor, Dynamic constructor, Destructors.

UNIT – IV

Operator Overloading: Defining operator overloading, Overloading Unary operators, Overloading Binary operators, Overloading Binary operators using Friends.

Inheritance: Introduction, Single Inheritance, Multilevel Inheritance, Multiple Inheritance, Hierarchical Inheritance, Hybrid Inheritance, Virtual base classes, Abstract classes.

UNIT – V

Pointers, Virtual Functions and Polymorphism: this Pointer, Virtual Functions, Pure virtual functions.

Managing Console I/O Operations: Unformatted I/O operations, Formatted console I/O operations.

Templates: Class Templates, Function Templates, Overloading Template functions, Memberfunction Templates.

Exception Handling: Basics of Exception handling, Exception handling mechanism.

Text Books:

1. The Complete Reference C++, Herbert Schildt, TMH 4th Edition.
2. Learning - Computer Science :A Structured Approach Using C++,2nd Ed., Forouzan, Thomson.
3. Object Oriented Programming With C++, E. Balagurusamy, TMH 6th edition.

Reference Books:

1. Object oriented programming with ANSI and TURBO C++, Ashok N Kamathane, Pearson education.
2. Object oriented programming with C++, Saurav Sahay, Oxford.
3. Learning C++ Programming: From Problem Analysis To Program Design, Malik, Thomson

<table>
<tr><th>Course Title</th><th colspan="5">Employability Skills</th><th colspan="3">B.Tech.
Open Elective-I</th></tr>
<tr><th>Course Code</th><th>Category</th><th colspan="3">Hours/Week</th><th>Credits</th><th colspan="3">Maximum Marks</th></tr>
<tr><td rowspan="2">20OE601</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Min</td><td colspan="3">External Exam Duration: 3 Hrs</td></tr>
</table>

Employability skills play an important role in one’s career. Professional skills are a person’s skill set and ability to perform a certain type of activity or task. Employability skills are a person’s ability to interact effectively with co-workers and customers. Hard skills are mainly applicable at the work place. Employability skills are applicable both at workplace and outside the work place. Employability skills complement the hard skills which are occupational requirement of a job. It also complements many other activities even outside the work place. Presently employability skills are increasingly sought out by employers in addition to standard qualification. There are instances of professions where employability skills proved to be more important, on a long term basis than occupational skills. Employability skills refer to behavior, communication, IT Skill, work ethics etc. which makes a person suitable to effectively work in a team. Studies suggest that employability skills are equally important indication of job performance as hard skills. The competency level of the worker increases with the Employability skills and takes him to the next level.

Course Objectives: The main objective of this course is to make the the students

Demonstrate effective presentations

ii. Develop and practice self-management skills

iii Assess and improve personal grooming

iv. Create safety awareness including rules and procedures on the work site.

v. Survey the required skills for discussing and resolving problems in the work arena.

Course Outcomes: On success Completion This course ,the students will be able to

CO1	Demonstrate presentations
CO2	Develop and practice self-management skills
CO3	Assess and improve personal grooming
CO4	Create safety awareness including rules and procedures on the work site.
CO5	Survey the required skills for discussing and resolving problems in the work arena.

Syllabus:

UNIT–1 Communication and Teamwork – Communicating effectively, Interpersonal and Intrapersonal skills, A good leader, Leadership behavior, Assertiveness skills.

UNIT -2 Etiquette and Manners – Social and Business. Time Management – Concept, Essentials Tips – prioritization, Kinesics, Adaptability Skills.

UNIT –3 Decision-Making and Problem-Solving Skills: Meaning, Types and Models, Ethical Decision-Making, Problems and Dilemmas in application of these skills. Conflict - Definition, Nature, Types and Causes; Methods of Conflict Resolution, Conflict Management.

UNIT -4 Stress Management: Stress - Definition, Nature, Types, Symptoms and Causes; Stress Analysis Models and Impact of Stress; Measurement and Management of Stress.
UNIT –5 Interview and Presentation Skills: Definition, in-depth perspectives of interviewer and interviewee, preparation – before, during, after, overcoming nervousness, tips for success, Interviewer and Interviewee – Presentation Skills: Types, Content, Audience Analysis, Essential Tips

References:

1. Barun K. Mitra, Personality Development and Soft Skills, Oxford University Press, 2011.
2. S.P. Dhanavel, English and Soft Skills, Orient Blackswan, 2010.
3. R.S.Aggarwal, A Modern Approach to Verbal & Non-Verbal Reasoning, S.Chand& Company Ltd., 2018.
4. Raman, Meenakshi& Sharma, Sangeeta, Technical Communication Principles and Practice,
5. Oxford University Press, 2011.
6. Managing Soft Skills for Personality Development – edited by B.N.Ghosh, McGraw Hill
7. India, 2012. 6. English and Soft Skills – S.P.Dhanavel, Orient Blackswan India, 2010.

<table>
<tr><td>Course Title</td><td colspan="4">ADVANCED NUMERICAL METHODS (R20)</td><td colspan="3">OPEN ELECTIVE - I</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE602</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hours</td></tr>
</table>

Course Objectives:

To solve algebraic, transcendental equations and system of linear equation by various methods.
To interpolate and approximate equal and unequal intervals by various formulae.
To discuss approximation of numerical differentiation and integration.
To solve Ordinary Differential Equations (ODEs) in initial value problems (IVPs) by various methods.
To solving ODEs & partial Differential Equations (PDEs) in boundary value problems (BVPs) by various methods.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the basic knowledge on solution of system of equations.
CO 2	Use interpolation and approximation to solve engineering problems.
CO 3	Estimate the numerical differentiation and integration.
CO 4	Apply initial value problems for solving first order differential equation.
CO 5	Discuss the boundary value problems in ordinary and partial differential equations.

UNIT I:

Solution of Equations: Solution of algebraic and transcendental equations- Fixed point iteration method, Horner's Method.

Solution of linear system of equations: Gauss Crout's Method, Relaxation method.

UNIT II: Interpolation and Approximation

Finite Differences-Other Difference Operators- To find one or more missing terms. Divide Difference -Newton's divided difference interpolation, Inverse interpolation formula.

UNIT III: Numerical Differentiation and Integration

Numerical differentiation: Finding first and second order derivatives using Newton's formulae. Numerical integration: Newton - Cote's quadrature formulae, Trapezoidal rule, Simpson's 1/3 rule, Simpson's 3/8 rule.

UNIT IV:Initial Value Problems for Ordinary Differential Equations

Single Step methods: Taylor's series method, Euler's method, Fourth order Runge - Kutta method for solving first order equations.

Multi step method: Milne's predictor - corrector method.

UNIT V: Boundary Value Problems in Ordinary and Partial Differential Equations

Finite difference methods for solving two-point linear boundary value problems - Finite difference techniques for the solution of two dimensional Laplace's equation.

Text books:

1. Grewal.B.S., and Grewal.J.S., "Numerical methods in Engineering and Science", Khanna Publishers, 9th Edition, New Delhi, 2007.
2. Kandasmay,P; Thilagavathy, K; Gunavathi, K, Numerical Methods, S.Chand And Company Ltd, 2007.

3. Applied Numerical Analysis, Pearson Publishers, 7th Edition, Curtis F. Gerald, Patrick O. Wheatley.
4. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 10th edition Reprint 2021.

Reference Books:

1. Chapra.S.C., and Canale.R.P., “Numerical Methods for Engineers, Tata McGraw Hill, 5th Edition, New Delhi, 2007.
2. Sankara Rao. K., “Numerical methods for Scientists and Engineers”, Prentice Hall of India Private, 3rd Edition, New Delhi. 2007.
3. Applied Numerical Methods with MATLAB for Engineers and Scientists, Special Indian Edition, Steven C Chapra.
4. Advanced Engineering Mathematics, Neil Opeter V.

Course Title	ENGINEERING MATERIALS					OPEN ELECTIVE- 1		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
	BSC	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End lab Exams**	**Total**
		3	**0**	**0**	**3**	40	60	100
					End Exam Duration: 3Hrs			

COURSE OBJECTIVES:

1.This introductory course is aimed to obtain basic exposure to the concepts of crystalline solids, its imperfections and basics of various advance engineering materials finding wide spread application in several industries.
2.Describe the process that is used to produce glass-ceramics.
3.To enlighten the periodic arrangement of atoms in crystals to provide fundamentals related to structural analysis through powder diffraction method.
4.Understanding these material systems are vital for investigating the defects and their nature on these classes of materials.

Course Outcomes: Upon completion of the course, the student will be able to:	
CO1	**Classify** various crystal systems.
CO2	**Explain** the applications of magnetic materials.
CO3	**Analyze** the various metallurgical factors influencing the performance of materials for different Structural engineering applications.
CO4	**Interpret** Lorentz field and Claussius-Mosotti relation in dielectrics.
CO5	**Identify** applications of semiconductors in electronic devices .

Unit –I: Structure of Metals

Introduction-Different types of bonding in solids – Space lattice, Basis, unit cell and lattice parameters – Bravais Lattice – Crystal systems – Packing fraction – Coordination number – Packing fraction of SC, BCC .

Unit– II: Magnetic Materials

Introduction to magnetic materials - Classification of magnetic materials: Dia, Para & Ferro – Domain concept of Ferromagnetism (Qualitative) – Hysteresis loop– Soft and Hard magnetic materials.

Unit– III: Ceramics

Introduction-Types and applications of ceramics- Glasses - Glass-Ceramics - Clay Products - Refractories - Abrasives Cements - Advanced Ceramics - Materials of Importance—Piezoelectric Ceramics

Unit –IV: Dielectric Materials

Introduction to Dielectrics-Electric polarization- Dielectric polarizability, Susceptibility and Dielectric constant-Types of polarizations(Qualitative)–Frequency dependence of polarization-Lorentz(internal) field- Classius-Mosotti equation- Applications of Dielectrics

Unit –V: Electrical Properties of materials

Electrical conduction: - Ohm’s Law - Electrical Conductivity- Electronic and Ionic Conduction - Energy Band Structures in Solids.

Semiconductivity:- Intrinsic Semiconductor - Extrinsic Semiconductor - The Temperature Dependence of Carrier Concentration - Hall Effect - Applications

Text Books:

1. Callister’s Materials Science and Engineering: Wiley, Second Edition, (2018)
2. V. Raghavan, Materials Science and Engineering, Prentice Hall of India, 5th edition (2013).
3. G.E. Dieter, Mechanical Metallurgy, Mc-Graw Hill, 3rd edition (2013).

Reference Books:

1. L. H. Van Vlack, Elements of Materials Science and Engineering, Addison Wesley, 6th edition (1989).
2. I. J. Polmear, Light Alloys: Metallurgy of the Light Metals, Wiley, 3rd edition (1995).
3. V. Raghavan, Physical Metallurgy: Principles and Practice, PHI Learning Private Limited, 2nd edition (2006).

Course Title	Basics of Nanotechnology					**B. Tech. (Open elective-I)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE604	**Open Elective**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:
To make the students acquire an understanding the Nanoscience and Applications
Student will be able to understand and control matter at the nanoscale leads to a revolution in technology and industry that benefits society.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Acquire knowledge about structure and properties of nano materials
CO 2	Synthesis of nanomaterials by various methods & their applications
CO 3	Identify and understand various top-down and bottom-up approaches for nanomaterial synthesis
CO 4	Correlate properties of nanostructures with their size, shape
CO 5	Appreciate enhanced sensitivity of nanomaterial-based sensors and their novel applications in industry

Unit-I: Introduction
History and Scope, Introduction to nanomaterials, Classification of nanomaterials with suitable examples, Structure of different nanomaterials- Graphenes, CNT's, Fullerene, Properties of nanomaterials-Chemical, Optical, Thermal , Electrical Mechanical.

Unit-2: Synthesis of Nanomaterials
Chemical precipitation and Co-precipitation, Sol-gel synthesis, Electrochemical synthesis, Photochemical synthesis, Evaporation method-Principal & its uses

Unit-3: Fabrication of Nanomaterials
Top-Down method (Ball milling), Bottom-up method (chemical vapour deposition method, Sol gel method), Self- assembly method, Electric arc method. Nanocomposite fabrication.

Unit-4: Properties of Nanomaterials
Importance of nano particle, effect of Size on optical, electronic, photonic, mechanical, magnetic and catalytic properties.

Unit-5: Applications of Nanomaterials
Applications of Nano electronics, Nanooptics, Nano scale chemical & biosensing, biological/ Biomedical applications, Photo voltaic fuel cells-Related applications

Textbooks:

1. Text Book of Engineering Chemistry, Shashi Chawla, Dhanapath Rai Publications, New Delhi, 4th Edition, 2011.
2. Textbook of Nanoscience and Nanotechnology in Engineering, Marcel Van de Voorde (Ed.), De Gruyter publications

3. Nanoparticles-Biological activities and nanotechnology, Mindy Adams, NY Research Press
4. Theory and applications of Nano particals, Andrew Green, NY Research Press

Reference Books:

1. Textbook of Nanoscience & Nanotechnology, B.S. Murthy p. Shankar Baldev, University Press-IIM
2. Nanotechnology- A future technology with Visions-BPB Publications
3. Nanotribology, edited by Stephen M. Nsu, Z. Charles Ying, Springer International Edition
4. Introduction to Nanotechnology, Charles P. Poole Jr. Frank J. Owens, Willey Students Editions.

<table>
<tr><td>Course Title</td><td colspan="5">WRITE IT RIGHT</td><td colspan="3">OPEN ELECTIVE - I</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE605</td><td rowspan="2">HUM</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hours</td></tr>
<tr><td colspan="9">Course Objectives:
1.To help students get the basics right.
2.To grasp the nature of the writing exercise one has embarked upon
3. To promote effective writing across a whole range of tasks that all of us face on a daily basis</td></tr>
</table>

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Utilize effective techniques for writing job applications /course application.
CO 2	Recall the contents to make use of good paragraph writing.
CO 3	Identifying grammatical errors and can make necessary corrections.
CO 4	Demonstrate effective grammatical skills in English.
CO 5	Paraphrase a piece of writing and summarize it easily.

Unit 1.
1. The logic of Effective Writing
2. Applying for a course: Applying for a job
3. Writing Correct and Convincing sentences

Unit 2:
1. Generating Ideas through Prewriting
2. Using the Patterns of Paragraph Development:

a. Narration
b. Description
c. Argument
d. Exposition

Unit 3:
1. Punctuation – list of punctuation marks- their usage for effective written communication
2. Misplaced modifiers
3. Confused words
4. Common mistakes in English
5. The Right Use of the definite article

Unit4:
1. Report writing – types – sample reports
2. e-mail writing
3. Elements of good essay

Unit 5:
1. Precise Writing
2. Developing of an idea/ Expansion

3. Note-making

Text books:

1. Write it Right: A Handbook for Students authored by John Peck and Martin Coyle published by Palgrave Macmillan in New York and Hampshire in 2005.
2. Odyssey- A Guide to Better Writing by William. J. Deborah Lawton Published by Allyn and Bacon.

Reference books

1. Heffron, Jack (ed). The Best Writing on Writing. Story Press, Cincinnati, Ohio, 1994. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.

2. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.Oxford Learners Dictionary, 12 th Edition, 2011

Course Title	Human Capital Management					B.Tech. Open Elective-1		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE606	Open Elective (OEC)	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Min						**End Exam Duration: 3Hrs**		

Course Objectives: The objective of the course is
ToenablethestudentstounderstandtheHRManagementandsystematvariouslevelsingeneralandincertainspecificindustriesororganizations.
To help the students focus on and analyze the issues and strategies required to select and develop man power resources.
To develop relevant skills necessary for application in HR related issues.
ToEnablethestudentstointegratetheunderstandingofvariousHRconceptsalongwiththedomainconceptinordertotakecorrectbusinessdecisions.

Course Outcomes: On successful completion of this course, the students will be able to

CO1	UnderstandingofrolesandresponsibilitiesofHRdepartmentinindustries.
CO2	Have knowledge to understand job analysis and design jobs.
CO3	Understand job evaluation and estimate HR requirements.
CO4	Able to conduct recruitment & selection process.
CO5	Abletounderstandtrainingmethods.Haveclarityofemployeecompensation

Unit-I

Introduction of HRM: Nature, scope, objectives, Importance and functions, Evolution of the concept of HRM, Human resource management in India; Roles of HR manager, Practice in Industry

Unit-II

Job Analysis &Design: Job Analysis-Meaning, Uses, Process and methods of collecting data for job analysis, Job Description, Job Specifications, Factors affecting Job Design, Techniques of Job Design.

Unit-III

Job Evaluation and Human Resources Planning: Objectives of Job Evaluation; Advantages and Limitations of Job Evaluation, Human Resources Planning (HRP), Need and Benefits of HRP, Process of HRP ,Factors Affecting HRP, Responsibility for HRP.

Unit-IV

Recruitment & Selection: Factors Affecting Recruitment; Sources of Recruitment; Selection Process, Methods of selection-Interviews, Tests, Need for Training and Methods of Training.

Unit-V

Human Resource Development: Meaning, Definition of HRD, objectives, Significance, functions and HRD process.

Text Books:

1. HumanResourceandPersonnelManagement-TextandCases:K.Ashwathappa,TataMcGrawHillEducationPvt.Ltd.
2. PersonnelandHumanResourceManagement-P.SubbaRao,HimalayaPublishing.
3. Human Resource Management – John M Lvancevich (1988) Publish – Irwin Mcgraw Hill.
4. Human Resource Management – Greg L. Stweart John wiley & sons, Inc Publications.
5. Human Resource Development_ Mohammad mohsim (2010) Publisher Vdm Verldg Dr. Muller.

Reference Books:

1. Human Resource Management: P.Jyothi, Publication, Oxford University Press

<table>
<tr><td>Course Title</td><td colspan="4">Power Systems - I Lab</td><td colspan="4">B.Tech V SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002507</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">-</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to determine the sequence impedances of alternators and transformers, study the faults on an unloaded synchronous machine, characteristics of relays and simulate the power flows.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Evaluate sequence Impedances of 3 Phase Alternator and Transformers.</td></tr>
<tr><td>CO 2</td><td colspan="8">Compare the fault Currents for different faults on unloaded Synchronous Generators.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the Characteristics of Relays.</td></tr>
<tr><td>CO 4</td><td colspan="8">Estimate the line parameters of a transmission line.</td></tr>
</table>

List of experiments (Any Eight)

Power Angle Curve of a synchronous Generator
Determination of sequence reactance of 3-Φ Alternator
Determination of sequence impedance of 3-Φ Transformer
Operating Characteristics of Over Current-Relay
Operating Characteristics of Over/Under Voltage-Relay
Operating Characteristics of Differential Relay
Ferranti effect, Surge impedance loading and ABCD parameters of 220kV transmission line
Symmetrical Fault Analysis at the Terminals of an Unloaded 3-Φ Alternator
Single Line to Ground Fault and Line to Line Fault with and without impedance at the Terminals of an Unloaded 3-Φ Alternator
Double line to Ground Fault with and without impedance at the Terminals of an Unloaded 3-Φ Alternator

<table>
<tr><td>Course Title</td><td colspan="4">Internet of Things (IoT) Lab</td><td colspan="3">B.Tech V SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002508</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the basics of Arduino/ Raspberry Pi, Sensors, Actuators and design applications relevant to the IoT Technologies.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the Concepts of IoT.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand Software and Hardware skills of Arduino / Raspberry Pi.</td></tr>
<tr><td>CO 3</td><td colspan="8">Able to Develop the C/Python Programming on Arduino / Raspberry Pi.</td></tr>
<tr><td>CO 4</td><td colspan="8">Design Simple Applications of IoT.</td></tr>
</table>

List of Experiments (Any Eight)

2. To interface LEDs with Arduino / Raspberry Pi and write a program to build a Binary Counter.
3. To interface Push button with Arduino / Raspberry Pi and write a program to turn ON/OFF LED when push button is pressed.
4. To interface Potentiometer with Arduino / Raspberry Pi and write a program to Create Dimmable LED.
5. To interface LDR with Arduino / Raspberry Pi and write a program to turn ON RGBLED to get Mixing Primary Colors.
6. To interface IR Sensor with Arduino / Raspberry Pi and write a program to turn ON LED when sensor detects an object.
7. To interface an Ultrasonic Sensor with Arduino / Raspberry Pi and write a program to Measure how much is the distance of the object from the Sensor on LCD Display.
8. To interface a Servo motor with Arduino / Raspberry Pi and write a program to rotate the Servo motor.
9. To interface OLED with Arduino / Raspberry Pi and write a program to print LED ON/OFF.
10. To interface BULB using relay with Arduino / Raspberry Pi and write a program to turn ON/OFF the Bulb.
11. To interface a DHT11 sensor with Arduino / Raspberry Pi and write a program to print temperature and humidity readings.
12. To interface Bluetooth with Arduino / Raspberry Pi and write a program to turn LED ON/OFF when ‘1’/’0’ is received from a smartphone using Bluetooth.

13. Write a program on Arduino / Raspberry Pi to upload temperature and humidity data to ThingSpeak cloud.

Reference Books

Dr. SRN Reddy, Rachit Thukral and Manasi Mishra, “Introduction to Internet of Things: A practical Approach”, ETI Labs
Jeeva Jose, “Internet of Things”, Khanna Publishing House, Delhi
Adrian McEwen, “Designing the Internet of Things”, Wiley
Cuno Pfister, “Getting Started with the Internet of Things”, O Reilly Media

<table>
<tr><td>Course Title</td><td colspan="4">Soft Skill Oriented Course
(Advanced English Communication Skills)</td><td colspan="3">B.Tech V SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002509</td><td rowspan="2">Skill Course
(SC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>1</td><td>--</td><td>2</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objectives of this course is to make the students interpret using language effectively in Group Discussions, develop the required skills for facing interviews and public speaking, analyze improving of language proficiency, build confidence by exposing to various situations and contexts for their successful professional career and develop them industry – ready.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to,</td></tr>
<tr><td>CO 1</td><td colspan="8">Interpret using language effectively in Group Discussions.</td></tr>
<tr><td>CO 2</td><td colspan="8">Develop the required skills for facing interviews and public speaking.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze improving of language proficiency.</td></tr>
<tr><td>CO 4</td><td colspan="8">Build confidence by exposing to various situations and contexts for their successful professional career.</td></tr>
<tr><td>CO 5</td><td colspan="8">Develop them industry – ready.</td></tr>
</table>

Introduction

A course on Advanced English Communication Skills (AECS) is considered essential at the third year level of B.Tech course. At this stage, the students need to prepare themselves for their career which requires them to listen to, read, speak and write in English both for their professional and interpersonal communication. The main purpose of this course is to prepare the students of Engineering for their placements.

A. Syllabus:

The following course content is prescribed for the Advanced English Communication Skills:

1.Functional English -- Starting & Responding to a Conversation-- Social Etiquette, Formal and informal Conversation -- Role play – Body language in conversation—departing phrases.

2.Technical Report Writing --- Types of formats and styles, subject matter, organization, clarity, coherence and style, data-collection, tools, analysis, sample report.

3.Resume' Writing --- Structure, format and style, planning, defining the career, objective, projecting one's strengths and skills, creative self-marketing, cover letter.

4.Group Discussion--- Communicating views and opinions, discussing, intervening.Providing solutions on any given topic across a cross-section of individuals, (keeping an eye on modulation of voice, clarity, body language, relevance, fluency and coherence) in personal and professional lives.

5. Interview Skills --- Concept and process, pre-interview planning, mannerisms, body language, organizing, answering strategies, interview through tele and video-conferencing.

B. Minimum Requirements
The English Language Lab shall have two parts:
The Computer aided Language Lab for 60 students with 60 systems, one master console, LAN facility and English language software for self-study by learners.
The Communication Skills Lab with movable chairs and audio-visual aids with a P.A System, a TV, A digital stereo-audio and video system, Camcorder etc.
System Requirements (Hardware Components):
Computer network with LAN with a minimum of 60 multimedia systems with the following specifications:
P-IV Processor, Speed-2.8 GHz, RAM_512 MB minimum, Hard Disk-80 GB, Headphones
Prescribed Software: Walden and K-Van Solutions.

Books Suggested for English Language Lab Library (to be located within the lab in addition to the CDs of the text book which are loaded on the systems):

Technical writing and professional communication, Huckin and Olsen Tata McGraw-Hil 2009.

Speaking about Science, A Manual for Creating Clear Presentations by Scott Morgan and Barrett Whitener, Cambridge University press, 2006.

Handbook for Technical Writing by David A McMurrey& Joanne Buckely CENGAGE Learomg 2008.

Technical Communication by Meenakshi Raman &Sangeeta Sharma, Oxford University Press 2009.

The ACE of Soft Skills by Gopal Ramesh and Mahadevan Ramesh, Pearson Education, 2010.

Cambridge English for Job-Hunting by ColmDownes, Cambridge Unicversity Press, 2008.

Resume's and Interviews by M. Ashraf Rizvi, Tata McGraw-Hill, 2008.

From Campus to Corporate by KK Ramachandran and KK Karthick, Macmillan Publishers India Ltd, 2010.

English Language Communication: A Reader cum Lab ManualDr A Ramakrishna Rao, Dr G Natanam& Prof SA Sankaranarayanan, Anuradha Publications, Chennai 2008.

Course Title	Community Service Project					B.Tech V SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002510	**PROJ**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		--	**--**	**3**	**1.5**	**100**	**--**	**100**
Course Objective: The objective of the project is to enable the student to take up investigative study for social relevance.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand core concepts and research findings relative to human development, socialization, group dynamics and life course processes.							
CO 2	Identify and transfer existing ideas into new contexts and applications.							
CO 3	Apply and transfer academic knowledge into the real-world.							
CO 4	Design a component or a product applying all the relevant standards and with realistic constraints.							

The following are the rules and regulation for **Community Service Projects:**
The student has to spend 50 to 60 Hrs in the semester on any project (Social Relevance) and submit a report for evaluation.
The project is evaluated for 100 marks in the semester by a committee consisting of head of the department, project mentor and one senior faculty member of the department.
A student shall acquire 1.5 credits assigned, when he/she secures 50% or more marks from the total of 100 marks.
In case, if a student fails, he/she shall resubmit the report.
There is no external evaluation for the socially relevant project.

Course Title	Constitution of India					B.Tech V SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20MC512	**Mandatory Course (MC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		2	**0**	**0**	**0**	**40**	**00**	**30**
Mid Exam Duration : 1Hr30M								

Course Objectives: The main objective of the course is to learn
Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective.
To address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.
To address the role of socialism in India after the commencement of the Bolshevik.
Revolution in 1917 and its impact on the initial drafting of the Indian Constitution.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
CO 2	Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
CO 3	Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
CO 4	Discuss the passage of the Hindu Code Bill of 1956.

UNIT - I
History of Making of the Indian Constitution: History, Drafting Committee, (Composition & Working), Philosophy of the Indian Constitution: Preamble Salient Features.

UNIT - II
Contours of Constitutional Rights & Duties: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

UNIT - III
Organs of Governance: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications, Powers and Functions.

UNIT - IV
Local Administration: District's Administration head: Role and Importance, Municipalities:

Introduction, Mayor and role of Elected Representative, CEO of Municipal Corporation.
Panchayati raj: Introduction, PRI: Zila Panchayat., Elected officials and their roles, CEO Zilla Panchayat: Position and role.
Block level: Organizational Hierarchy (Different departments),
Village level: Role of Elected and Appointed officials, Importance of grass root democracy

UNIT - V

Election Commission: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners.
State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

Reference Books:

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition, 2015.

B.Tech VI SEM EEE (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Microprocessors & Microcontrollers</td><td colspan="3">B.Tech VI SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002601</td><td rowspan="2">Professional Core Course
(PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration : 1Hr30M</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn 8086 Microprocessor and 8051 Microcontroller Architecture, Instructions, Operating Modes and Programming, 8086 microprocessor and 8051 microcontroller for various applications and to study various peripherals for microprocessor based systems.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Define various components and list out various features of microprocessor, microcontroller and peripherals.</td></tr>
<tr><td>CO 2</td><td colspan="8">Describe the internal block diagram of microprocessor, microcontroller and peripherals, addressing modes, instruction set and data transfer schemes.</td></tr>
<tr><td>CO 3</td><td colspan="8">Develop algorithm and assembly language programs to solve problems.</td></tr>
<tr><td>CO 4</td><td colspan="8">Apply an appropriate algorithm, program and peripheral for the application.</td></tr>
<tr><td>CO 5</td><td colspan="8">Design the microprocessor or microcontroller based system to solve real time problems. (Prepare a case study model to get a first prototype)</td></tr>
</table>

UNIT - I

Introduction to Microprocessors: 8085 Microprocessor - Architecture, Instruction set, Addressing modes, Basic Timing Diagrams, Interrupts and Simple Programs.

8086 Microprocessor - Architecture, Instruction set, Addressing modes, Interrupt system. Pin diagram, Minimum mode 8086 system and timings, Maximum mode 8086 system and timings.

UNIT - II

Assembly Language Programming: Assembler directives, Assembly language programs (8086) with Assembler directives for addition, subtraction, multiplication, division etc., sorting and searching, bit manipulation, look-up tables, string manipulations, Macros and Delay subroutines.

Data transfer schemes and Memory Interfacing: Synchronous, Asynchronous, Interrupt driven and DMA type schemes, Address decoding techniques, Interfacing Static RAM and ROM chips.

UNIT - III

Peripheral Interfacing: 8255 PPI and its interfacing, Programmable Communication Interface (8251 USART) and its interfacing, Programmable Interval Timer (8254) and its interfacing, Programmable interrupt controller (8259) and its interfacing, Programmable DMA controller (8257) and its interfacing, ADC and DAC Interfacing.

UNIT - IV

The 8051 microcontroller: Architecture, pin diagram, memory organization, external memory interfacing, stack, addressing modes, instruction set, Assembler directives, Assembly Language programs and Time delay Calculations, 8051 interrupt structure, 8051 counters and Timers, programming 8051 timers.

UNIT - V

Introduction to ARM: ARM Design philosophy, Registers, Program Status Register, Instruction pipeline, Interrupts and vector table, Instruction Set- Data Processing Instructions, Branch, Load-Store, Software interrupt, PSR instructions, Conditional instructions, Thumb instruction Set: Register Usage, Single-Register and Multi Register Load-Store Instructions.

Text Books:

1. Ramesh S. Gaonkar, “Microprocessor architecture, programming and its applications with 8085”, Penram International Publications, 4th Edition.
2. A. K. Ray and K.M. Bhurchandi, "Advanced Microprocessors and Peripherals", TMH.
3. The 8051Microcontroller and Embedded Systems, Mazidi Muhammad Ali, Mazidi Janice Gillespie & McKinlay Rolin D, 2nd Edition, Pearson Education, 2008.
4. The 8051 microcontroller: Architecture, Programming & Applications, Kenneth J Ayala, penram publications, 2nd edition.

Reference Books:

1. Douglas V. Hall, "Microprocessors and Interfacing: Programming and Hardware", 2nd Edition, Tata McGraw-Hill.
2. Barry B. Brey, “The Intel Microprocessors-Architecture, Programming and Interfacing”, 8th Edition, PHI.
3. Y. Liu and Glenn A. Gibson, “Microcomputer Systems: 8086/8088 Family Architecture, Programming and Design”, 2nd Edition, PHI.
4. Microcontrollers Architecture, Programming, Interfacing and System Design – Raj Kamal, Pearson Education, 2005.

Course Title	Fundamentals of Electric Drives					B.Tech VI SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002602	**Professional Core Course (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration : 1Hr30M						**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to learn various speed control methods of AC & DC drives fed from power converters, multi-quadrant operation of drives and conservation of energy in electrical drives.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand block diagram and dynamics of electrical drives.							
CO 2	Acquire the knowledge of power electronic converters and their control to AC and DC machines.							
CO 3	Analyze the working operation and solution to numerical problems of the drives and machines.							
CO 4	Apply the acquired knowledge in implementation and choosing of power electronic converters to their relevant motors.							
CO 5	Understand energy conservation in electrical drives with the usage of efficient motors and converters							

UNIT – I

Electrical Drives: Introduction – Electrical Drives, Advantages of Electrical Drives, Block Diagram of Electrical drives – status of dc and ac drives.

Dynamics of Electrical Drives: Fundamental Torque Equation, Speed-Torque Convention and multi quadrant operation, loads with rotational motion, loads with translational motion, measurement of moment of inertia, components of load torques, Nature and classification of load torques.

UNIT – II

Control of Electrical DC-Drives –Modes of operation, speed control and drive classifications, closed loop control of drives.

D.C. Motor Drives: Speed control, Armature voltage control, and Controlled rectifier fed DC drives 1-Φ and 3-Φ fully controlled and half controlled converter fed separately Excited D.C. Motor (discontinuous and continuous mode), chopper controlled DC drives (separately Excited motor)- Braking Methods.

UNIT – III

Control of Induction Motor from Stator Side: Variable voltage Characteristics-Control of Induction Motor by Ac Voltage Controllers – Waveforms – speed torque characteristics.

Variable frequency and Variable voltage control of induction motor by Voltage source inverter, Closed loop operation of induction motor drive (Block Diagram Only)
Control of Induction Motor from Rotor Side: Static rotor resistance control – Slip power recovery – Static Scherbius drive – Static Kramer Drive – their performance and speed torque characteristics

UNIT – IV

Synchronous Motor Drives –Cylindrical rotor wound field motor-salient pole wound filed motor- Torque Expression – self-controlled synchronous motors employing load commutated Thyristor inverter, self-controlled synchronous motors employing Cyclo converter, Brushless DC motor Drives – BLDC for servo applications.

UNIT – V

Energy Conservation in Electrical Drives – Losses in Electrical Drive System, Measures of energy conservation in Electrical drives, use of efficient Converters, Energy Efficient operation of drives, improvement of P.F.- improvement of quality of supply- maintenance of motors.

Text Books

1. Fundamentals of Electrical Drives by G. K. Dubey, Narosa Publications
2. Power Electronic Circuits, Devices and Applications by M. H. Rashid, PHI

Reference Books

1. Power Electronics by M.D. Singh and K. B. Khanchandani, TMH, 1998.
2. Modern Power Electronics and AC Drives by B. K. Bose, PHI.
3. Thyristor Control of Electric Drives by Vedam Subramanyam, TMH
4. Analysis of Thyristor Power Conditioned Motors by S. K. Pillai, Universities Press, 1st edition.

Course Title	**Switchgear & Protection**					**B.Tech VI SEM EEE (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002603	**Professional Core (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**30**	**70**	**100**
Mid Exam Duration : 1Hr30M						**End Exam Duration : 3Hrs**		

Course Objectives: The main objective of the course is to learn about the different types of electromagnetic relays and microprocessor based relays, protection of Generators, Transformers, feeders and lines, Generation of over voltages and protection from over voltages, The technical aspects involved in the operation of circuit breakers.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Identify the Main Components And Features Of A Protection System.
CO 2	Understand Fault Clearing Phenomena And Feasibility Protection Systems Needed For Power System.
CO 3	Understand Construction And Working Of Various Types Of Circuit Breakers And Relays.
CO 4	Applying Conventional And Numerical Relays The Protection Of Rotating Machines Bus bars Transformers Transmission Lines And Distribution Networks.

UNIT-I

Over Voltages in Power Systems: Cause of over voltages, protection against lightning over voltages, ground wires, counterpoises, surge absorbers and surge diverters ,lightning arresters(valve type),ratings of Lightning arresters, insulation coordination, neutral earthing-types.

UNIT-II

Circuit Breakers: Elementary principles of arc interruption, restriking and recovery voltages, average and maximum RRRV, numerical problems. Current chopping and resistance switching-circuit breaker ratings, auto reclosure and problems. Description and operation of minimum oil circuit breakers, air break circuit breakers, vacuum circuit breakers and sulphur hexafluoride circuit breakers.

UNIT-III

Protective Relays: Basic requirements of relays, relay terminology, types of relays, electromagnetic relays (attraction type and induction type). Construction and operation of non-directional and directional over current relays, universal torque equation, operating characteristics of impedance, reactance and admittance relays. Principle and operation of differential and percentage differential relays.

Static Relays: Advantages and Dis-advantages, amplitude comparators and phase comparators.

UNIT-IV

Protection of Generators: protection of generators against stator faults, rotor faults and abnormal running conditions, restricted earth fault protection and inter turn fault protection, numerical problems on percentage winding unprotected.

Protection of Transformers: Percentage differential protection of transformers, numerical problems on design of CT's ratio, Buchholz relay.

UNIT-V

Protection of Feeders and Lines: Protection of feeders (radial and ring main) using over current relays, protection of transmission lines by three zone protection using distance relays, carrier current protection and protection of bus-bars.

Text Books:

1. Power System Protection and Switchgear by Badriram & D. N. Vishwakarma, TMH Publishing Company Ltd., 1995.
2. Electrical Power Systems by C. L. Wadhwa, New Age International (P) Limited, 3rd Edition.

Reference Books:

1. Fundamentals of Power System Protection by Y. G. Paithanakar and S. R. Bhide, PHI, 2nd Edition.
2. Power System Protection and Switchgear by Bhuvanesh Oza, TMH, 2010.

Course Title	**Power System Operation & Control (PEC – II)**					**B.Tech VI SEM EEE (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002604	**Professional Core (PCC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration : 1Hr30M						**End Exam Duration : 3Hrs**		
Course Objectives: The objective of the course is to learn steady state and transient stability analysis, economic operation of power systems, hydrothermal scheduling, modeling of governor, generator, single area and two area load frequency control.								
Course Outcomes: On successful completion of this course, the students will be able to								

CO 1	Analyze the stability of the power system under different operating conditions.
CO 2	Understand optimal operation of thermal unit, hydrothermal scheduling and modeling of power system components for LFC studies.
CO 3	Analyze economic operation criteria of thermal unit, hydrothermal units, modeling of turbine and governor.
CO 4	Analyze load frequency control parameters in single and two area systems.
CO 5	Design suitable controllers to improve LFC dynamics in single and two area power systems.

UNIT I

Stability Studies: Classification of stability studies – the power flow equations of wound rotor and salient pole synchronous machine connected to an infinite bus through a transmission system – power angle diagrams – steady state stability and limits.

Transient Stability Analysis: General considerations and assumptions –inertia constant, derivation of swing equations, equal area criterion – application of equal area criterion to a) sudden increase in input b) sudden three phase fault on one of the lines of a transmission system – determination of critical clearing angle – clearing time- – limitations of equal area criterion, methods for improving power system stability.

UNIT II

Economic Operation: Optimal operation of thermal power units, - heat rate curve – cost curve–incremental fuel and production costs, input-output characteristics, optimum generation allocation with line losses neglected. Optimum generation allocation including the effect of transmission line losses – loss coefficients, general transmission line loss formula.

UNIT III

Hydrothermal Scheduling: optimal scheduling of hydrothermal system: hydroelectric power plant models, scheduling problems- short term hydrothermal scheduling problem.

Modeling of Turbine: First order turbine model, block diagram representation of steam turbines and approximate linear models.

Modeling of Governor: Mathematical modeling of speed governing system , derivation of small signal transfer function – block diagram.

UNIT IV

Load Frequency Control - I: Necessity of keeping frequency constant, definitions of control area, single area control, block diagram representation of an isolated power system, steady state analysis dynamic response, uncontrolled case.

UNIT V

Load Frequency Control-II: Load frequency control of two -area system – uncontrolled case and controlled case, tie-line bias control, proportional plus integral control of two area and its block diagram representation, steady state response, load frequency control and economic dispatch control.

Text Books

1. Electrical Power Systems by C.L. Wadhwa, New Age International Publishers, 6th Edition,
2. Power System Analysis Operation and Control by A. Chakravarthy and S. Halder, 3rd Edition, PHI, 2012.
3. Modern Power System Analysis by I. J. Nagrath & D. P. Kothari, Tata Mc Graw – Hill Publishing Company Ltd, 2nd Edition, 2003.
4. Power Systems Analysis and Stability by S.S.Vadhera, Khanna Publications.

Reference Books

1. Power System Analysis and Design by J. Duncan Glover and M.S. Sharma., THOMSON, 3rd Edition, 2008.
2. Electric Power Systems by S. A. Nasar, Schaum Outline Series, Revised 1st Edition, TMH, 2005.

<table>
<tr><td>Course Title</td><td colspan="5">High Voltage DC Transmission
(PEC-II)</td><td colspan="3">B.Tech VI SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002605</td><td rowspan="2">Professional
Elective
(PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 1Hr30M</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the student is to student able to learn fundamental concepts of HVDC, mainly focus on converter configuration and analysis for the application of High voltage transmission systems.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand various converter and Inverter circuits</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the applications of high voltage transmission system along with types of DC links.</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply various protection system for HVDC transmission.</td></tr>
<tr><td>CO 4</td><td colspan="8">Understand the use of filters for DC transmission.</td></tr>
</table>

UNIT-I

HVDC Power Transmission Technology: Introduction- Comparison of AC & DC transmission, Converter station, Description of DC Transmission systems, Choice of voltage level, Modern trends in DC transmission.

UNIT-II

Analysis of HVDC Converters: Pulse number, Choice of converter configuration, valve rating, Transformer, Simplified analysis of graetz-circuit with and without overlap, Rectifier and Inverter waveforms, Converter bridge characteristics.

UNIT – III

Converter and HVDC System Control: Principle of DC link control, Converter control characteristics, System and control hierarchy, Firing angle control, Converter and excitation angle control, Starting and stopping of DC Link , Power Control, Higher level Controllers.

UNIT – IV

Converter Faults: Protection against over currents, over voltages in a converter station, Surge arresters, Protection against over voltages. Smoothing reactor, DC Line, Transient over voltages in DC line, Protection of DC Line, DC breakers.

UNIT – V

Reactive Power Requirements in Steady State: Sources of reactive power, Static var systems, generation of Harmonics, Design of AC filters, DC filters, Carrier frequency and RI Noise.

Text Books

1. High Voltage Direct Current Transmission by J. Arilliga 2^{nd} edition, IEE Power and Energy Series.
2. High Voltage Direct Current Transmission by K. R. Padiyar, Wiley Eastern Ltd.,1993.
3. Direct current transmission by E. W. Kimbark, Wiley InterScience New York 1971.

Reference Books

1. EHVAC, HVDC Transmission and Distribution Engineering by S. Rao, Khanna Publishers, 2001.
2. Power Transmission by Direct Current by E. Uhlamann, Springer – Verlag, Berlin, 1975.

<table>
<tr><td>Course Title</td><td colspan="5">Signals & Systems (PEC-II)</td><td colspan="3">B.Tech VI SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002606</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 1Hr30M</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The main objective of the course is to analyze the response of linear, time-invariant dynamic systems to standard input signals and that can be applied to the various systems for the estimation of their performance.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Identify the various signals and operations on signals.</td></tr>
<tr><td>CO 2</td><td colspan="8">Describe the spectral characteristics of signals.</td></tr>
<tr><td>CO 3</td><td colspan="8">Illustrate signal sampling and its reconstruction.</td></tr>
<tr><td>CO 4</td><td colspan="8">Apply convolution and correlation in signal processing.</td></tr>
<tr><td>CO 5</td><td colspan="8">Analyze continuous and discrete time systems.</td></tr>
</table>

UNIT-I

Introduction: Definition and Classification of Signals, Elementary signals, Basic operations on signals.

Fourier series representation of periodic signals: Analogy between vectors and signals, Orthogonal signal space, Signal approximation using orthogonal functions, Mean square error, Closed or complete set of orthogonal functions, Orthogonality in complex functions. Representation of function by a set of mutually orthogonal functions, Dirichlet's conditions, Trigonometric Fourier series and Exponential Fourier series, Spectrum and its significance, Amplitude and Phase spectra.

UNIT-II

Fourier transforms: Fourier transform(FT), Fourier transform of standard signals, properties of Fourier transforms, Fourier transforms involving impulse function, Fourier transform of periodic signals.

UNIT-III

Signal transmission through LTI systems: Systems, Classification of Systems, Linear time invariant (LTI) system, Transmission of signals through LTI systems, Transfer function of a LTI system. Distortion less transmission through LTI system, Causality & Stability.

UNIT-IV

Discrete Time Signals: Sampling of continuous time signals, Sampling theorem, Reconstruction of signal from its samples, effect of undersampling – Aliasing. Representation of discrete time signals, Unit impulse, step, ramp, and exponential sequences, Operations on Discrete-time signals.

Discrete Time Systems: Definition, classification, Linear Shift Invariant(LSI) system, Stability , Causality , Linear constant coefficient difference equation , Impulse response , Discrete time Fourier transform , Transfer function , System analysis using DTFT.

UNIT-V

Laplace Transform: Definition , ROC , Properties , Inverse Laplace transform , The S-plane and BIBO stability , Transfer functions , System response to standard signals.

Z–Transforms: Z-transform- definition, ROC and its properties, analysis of LTI system using z-transform, The Inverse z-transform, z-transform properties.

Text Books:

1. Simon Haykin, "Communication Systems", 2nd Edition, Wiley-Eastern, 2003.
2. Oppenheim AV and Willisky, "Signals and Systems", 2nd Edition, Pearson Ed, 1997.
3. B.P. Lathi, "Principles of Linear systems and signals," Oxford Univ. Press, Second Edition International version, 2009.

Reference Books

1. Simon Haykin, Van Veen, and Wiley, "Signals & Systems", 2nd Edition, 2003.
2. Luis F. Chaparro, "Signals and Systems using MATLAB," Academic Press, 2011.

Course Title	**Solid Waste Management**					**B.Tech CE VI Sem (R20)**		
CourseCode	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE104	**Open Elective (OEC II)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1.5 Hrs						**End Exam Duration: 3 Hrs**		

Course Objectives:

To know the necessity of solid waste management
To study various strategies for the collection of solid waste
To understand various solid waste disposal methods
To understand how to categorize the Hazardous Wastes

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Understand and identify the physical and chemical composition of solid waste.
CO 2	Understand the optimum route planning for transport of solid waste.
CO 3	Understand the techniques and methods used in transformation, conservation, and recovery of materials from solid wastes.
CO 4	Understand the design of waste disposal systems.
CO 5	Understand the sources and how to manage the different categories of Hazardous Wastes.

UNIT - I

Introduction to Solid Waste

Definition - Types of solid waste - sources of solid waste - Characteristics - properties of solid wastes - Sampling of Solid wastes - Elements of solid waste management

UNIT - II

Solid Waste Management

Solid waste generation - onsite handling - storage and processing - collection of solid wastes - Stationary container system and Hauled container systems - Route planning - transfer and transport.

UNIT - III

Resource and Energy Recovery

Processing techniques - materials recovery systems - Composting - types of composting - Problems with composing – Pyrolisis – Gasification - RDF - recovery of energy from conversion products - materials and energy recovery systems.

UNIT - IV

Landfills

Types and Construction of landfills - Design considerations - Life of landfills - Landfill Problems - Lining of landfills - Leachate pollution and control - Landfills reclamation.

UNIT - V

Hazardous Waste Management

Sources and characteristics - Effects on environment - Risk assessment - Disposal of hazardous wastes - Secured landfills, incineration - Biomedical waste disposal - E-waste management

Text Books:

1. Tchobanoglous G, Theisen H and Vigil SA ‘Integrated Solid Waste Management, Engineering Principles and Management Issues’ McGraw-Hill, 1993.
2. Vesilind PA, Worrell W and Reinhart D, ‘Solid Waste Engineering’ Brooks/Cole Thomson Learning Inc., 2002.

Reference Books:

1. CPHEEO Manual on Municipal Solid Waste Management - 2000
2. Qian X, Koerner RM and Gray DH, ‘Geotechnical Aspects of Landfill Design and Construction’ Prentice Hall, 2002.
3. Peavy, H.S, Rowe, D.R., and G. Tchobanoglous, ‘Environmental Engineering’, McGraw Hill Inc., New York, 1985.

Course Title	**Estimation and Costing**					**B.Tech CE VI Sem (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE105	**Open Elective (OEC II)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1.5 Hrs						**End Exam Duration: 3 Hrs**		

Course Objectives:

To attain basic knowledge on types of quantity estimation of structures different types of structures and estimate quantities of load bearing wall structures
To interpret the rates of different items of works involved in a construction activity.
To understand various types & conditions of contracts and related documentation
To know about various techniques of valuation of land and building properties
To get basic knowledge on various types of costing along with cost control and reduction techniques.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Estimate quantities of various types of load bearing wall structures.
CO 2	Calculate the rates of different items of works involved in a construction activity.
CO 3	Know different types of contract documents as per requirements of a project.
CO 4	Do valuation of land and building properties.
CO 5	Do costing of a product using various techniques.

UNIT-I

Introduction to the Estimation of Structures

Introduction, Different Item of Works – Units of Item of works– Types of Estimates – Methods of Estimates.

Quantity Estimation of Buildings

Estimation of Quantities in Buildings: Load Bearing Wall Structure of Single Room and Multi Room

UNIT – II

Rate Analysis

Rate Analysis of Different Item of Works: Earthwork Excavation – Mortars of Various Proportions(Cement and Lime)–Concrete with Various Proportions (Lime and Cement) – Brick Masonry – Stone Masonry – Pointing – Painting – Plastering.

UNIT – III

Contracts

Types of Contracts, Contract Document, Conditions of Contracts, Contract Procedure, Termination of Contracts, Specifications, Important Conditions of Contract, Arbitration and Tenders.

UNIT – IV

Valuation

Introduction, Technique of Valuation, Elements of Valuation and Factors Affecting Valuation, Methods of Valuation to the Land Property and Building Property, Mortgage.

UNIT – V

Costing

Fixed and variable cost, Product and Process Costing, Standard Costing, Cost estimation, Relevant Cost for decision making, Cost estimation, Cost control and Cost reduction techniques.

Text Books:

1. B N Dutta “Estimating and Costing in Civil Engineering”, U B S Publishers DistributersPvt. Limited, Noida.
2. “Standard Data Book – Vol.2”, Andhra Pradesh Department of Standard Specifications,Amaravati.
3. Contracts and estimations by B.S.Patil, Universities.Press, Hyderabad
4. G.S. Birdie, Estimating and Costing, Danpatrai Publications, New Delhi, 2009
5. Riggs, J.L., Dedworth, Bedworth, D.B, Randhawa, S.U. Engineering Economics, McGraw Hill International Edition, 1996

Reference Books:

1. Dr. Roshan H Namavati “Professional Practice”, The Lakhani Book Depot, Mumbai.
2. S C Rangwala “Estimating Costing and Valuation”, Charotar Publishing House Pvt.Limited, Anand.
3. IS 1200 (Parts I to XXV–1974/ Method of Measurement of Building and Civil EngineeringWorks – B.I.S.)
4. M. Chakraborthi, Estimating Costing Specification and Valuation in Civil Engineering,23rd Edition, Laxmi Publications, New Delhi, 2010.

Course Title	Water Management					B.Tech CE VI Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20OE106	Open Elective (OEC II)	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 1.5 Hrs						End Exam Duration: 3 Hrs		

Course Objectives:
To understand different watershed behavior
To be able to interpret runoff data and quantify erosion by using various modelling methods.
To understand land use classification and impact of land use changes on hydrological cycle parameters.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Know concept and need for watershed management.
CO 2	Aware on various causes of soil erosion and mitigation methods.
CO 3	Implement basic rain water harvesting methods.
CO 4	Understand artificial groundwater recharge methods.
CO 5	Understand the soil reclamation methods.

UNIT – I
Introduction
Concept of watershed, need for watershed management, concept of sustainable development, hydrology of small watersheds.

UNIT – II
Soil Erosion
Principles of soil erosion- causes of soil erosion, types of soil erosion, estimation of soil erosion from small watersheds, Control of soil erosion, methods of soil conservation – structural and non-structural measures.

UNIT – III
Water Harvesting
Principles of water harvesting, methods of rainwater harvesting, design of rainwater harvesting structures.

UNIT – IV
Ground Water Recharge
Artificial recharge of groundwater in small watersheds-, methods of artificial recharge.

UNIT – V
Reclamation of saline soils
Micro farming - biomass management on the farm.

Text Books:

1. Murthy, V.V.N. and M.K. Jha Land and Water Management, Kalyani Publishers, 2015
2. Watershed Management by Madan Mohan Das and M.D. Saikia, Prentice Hall of India, 2013.

3. Watershed Management Muthy, J. V. S., New Age International Publishers, 1998.

Reference Books:

1. Watershed Hydrology by P E Black, Prentice Hall Englewood Cliffs, 1991.
2. Watershed Hydrology by R Suresh, Standard Publishers and Distributors, Delhi, 2020

Course Title	**Introduction to VLSI**					**Open Electives**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE403	**OE**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	-	--	3	40	60	100
Mid Exam Duration: 90Min					**End Exam Duration: 3Hrs**			

Course Objectives:
To introduce the concepts of IC fabrication technologies.
To understand scaling techniques of CMOS devices and their effects.
To study the methods to design the basic Gate level designs and draws their corresponding Layouts.
To provide basic idea of Subsystem design, PLDs and CMOS testing.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Understand the operation of a MOS transistor down to the physical level.
CO 2	Implement various logic gates and circuits using MOS transistors.
CO 3	Analyze PLD and FPGA families for logic design.
CO 4	Analyze various CMOS testing schemes.

Unit-I
Introduction to VLSI: Introduction to IC Technology – MOS, PMOS, NMOS, CMOS & Bi CMOS technologies- Oxidation, Lithography, Diffusion, Ion implantation, Metallization, Encapsulation.
Unit-II
Basic Electrical Properties: Basic Electrical Properties of MOS Circuits: Ids Vs Vds relationships, MOS transistor threshold Voltage, gm, gds, Figure of merit, Pass transistor, NMOS Inverter, CMOS Inverter analysis and Bi-CMOS Inverters.
Unit-III
VLSI Circuit Design Processes: VLSI Design Flow, MOS Layers, Stick Diagrams, Design Rules and Layout, 2μ CMOS Design rules for wires, Layout Diagrams for NMOS and CMOS Inverters and Gates, Scaling of MOS circuits, Limitations of Scaling.
Unit-IV
Subsystem Design: Basic circuit concepts: Sheet resistance, area capacitance and delay calculation, Subsystem Design, Shifters, Adders, ALUs, Multipliers, High Density Memory Elements.

Unit-V
Semiconductor IC Design and CMOS testing: PLAs, FPGAs, CPLDs, Standard Cells, ach. CMOS Testing, Need for testing, Test Principles, Design Strategies for test, Layout Design for improved Testability.

Text Books:

1. Kamran Eshraghian, Eshraghian Dougles and A. Pucknell, Essentials of VLSI circuits and systems, PHI, 2005 Edition.

2. Weste and Eshraghian, Principles of CMOS VLSI Design, Pearson Education, 1999.

Reference Books:

1. John .P. Uyemura, Introduction to VLSI Circuits and Systems, JohnWiley, 2003.
2. Wayne Wolf, Pearson Education, Modern VLSI Design, 3rd Edition, 1997.
3. S.M. SZE, VLSI Technology, 2nd Edition, TMH, 2003.

<table>
<tr><td>Course Title</td><td colspan="4">Principles of communication systems</td><td colspan="3">Open Electives</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE404</td><td rowspan="2">OE</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To understand the Basics of Telecommunication Engineering.
To introduce the Elements of Telecommunication systems.
To provide Knowledge about various communication systems</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the fundamental concepts of Telecommunication Engineering.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand use of different modulation techniques used in Analog and Digital Communication.</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand different Telecommunication systems like Satellite communication, Optical Fiber communication, Wireless communication, Mobile communication etc. and its applications.</td></tr>
<tr><td>CO 4</td><td colspan="8">Compare and contrast advantages and limitations of various Telecommunication systems.</td></tr>
</table>

Unit I

Basics of Telecommunication Engineering: Definition of Telecommunication, Examples of telecommunications and evolution, various types of telecommunication systems such as telephone network, Radio broadcasting system, Computer networks, Internet.

Unit II

Basic Elements of Telecommunication systems General Block schematic of communication system, Communication channels, Analog versus digital communication systems, Need of modulation, Types of analog modulation such as AM and FM, Types of digital modulation such as Pulse code modulation, delta modulation, Continuous wave modulation such as ASK, FSK, PSK.

Unit III

Introduction to Optical Fiber Communication: Use of optical fiber in communication, Principle and working of OFC system, Block diagram, Types of optical fibers, various elements required in designing OFC system, Applications such as long distance transmission links, Computer communication networks.

Unit IV

Introduction to Satellite Communication: Use of satellite in telecommunications, Launching of Satellite from earth station, Types of satellite orbits, Classification of satellite according to applications, Satellite communication link block diagram.

Unit V

Some concepts in Wireless communications: Wireless Standards: Overview of 2G and 3G, 4G cellular standards, Multiple access schemes-FDMA, TDMA, CDMA and OFDM, Modulation schemes- BPSK, QPSK. GSM, Wi-Fi & Wi-Max, Bluetooth, Recent Trends/Developments.

Text Books:

1. Simon Haykin," Communication Systems", 4th Edition, John Wiley Publication.
2. George Kenndey, " Electronics Communication systems", 4th Edition
3. John G. Proakis," Digital Communication", Tata McGraw Hill
4. T . Prat, C.W. Bostian," Satellite Communication", Wielly Publication

Reference Books:

1. S. Rappaport," Wireless communication – Principles and Practice", Pearson Education.
2. John M. Senior,"Optical Fiber Communication Principles and Practice",, Pearson Education.

<table>
<tr><td>Course Title</td><td colspan="5">Java Programming
(Open Elective Course-II)</td><td colspan="3">B. Tech VI Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE503</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To give the students a firm foundation on Java concepts like Primitive data types, Java control flow, Methods, Object-oriented programming, Core Java classes, packages and interfaces, multithreading.
To provide the students with an understanding of Java applets, Abstract Window, Toolkit and exception handling.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Solve problems using object oriented approach and implement them using Java.</td></tr>
<tr><td>CO 2</td><td colspan="8">Develop efficient programs with multitasking ability and handle exceptions.</td></tr>
<tr><td>CO 3</td><td colspan="8">Develop user friendly interface.</td></tr>
<tr><td>CO 4</td><td colspan="8">Create AWT components.</td></tr>
</table>

UNIT - I

Object Oriented Programming basics: Need for OOP paradigm, Principles of OOP concepts

Java Basics: History of Java, Java buzzwords, Simple java program, classes and objects – concepts of classes, objects, constructors, methods, introducing access control, **this** keyword, overloading methods and constructors.

UNIT - II

Inheritance: Hierarchical abstractions, Types of Inheritance, benefits of inheritance, **super** uses, using **final** with inheritance, polymorphism- method overriding, abstract classes.

Packages and Interfaces: Defining, Creating and Accessing a Package, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.

UNIT - III

Exception handling: Concepts of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, creating own exception sub classes.

UNIT - IV

Event Handling : Events, Event sources, Event classes, Event Listeners, The AWT class hierarchy, user interface components- Labels, Button, Scrollbars, Text Components, Check box, Choices, Layout manager types – Flow, Border, Grid, Card and Grid bag.

UNIT - V

Applets: Concepts of Applets, differences between applets and applications, life cycle of an Applet, creating applets, passing parameters to applets.

Swings: Icons and Labels, text fields, JButton class, Check boxes, Radio buttons, Combo boxes, and Tables.

Text Books:

1. Java; the complete reference, 7th editon, Herbert schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, Pearson Education.

3. An Introduction to programming and OO design using Java, J.Nino and F.A.Hosch, John wiley & sons.
4. An introduction to Java programming and object oriented application development, R.A. Johnson- Thomson.

Reference Books:

1. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell, eighth Edition, Pearson Education.
2. Core Java 2, Vol 2, Advanced Features, Cay.S.Horstmann and Gary Cornell, eighth Edition, Pearson Education.
3. Object Oriented Programming through Java, P. Radha Krishna, University Press.
4. Java and Object-Oriented programming Paradigm, Debasish Jana, PHI Learning Pvt. Ltd.

<table>
<tr><td>Course Title</td><td colspan="4">Web Designing
(Open Elective Course-II)</td><td colspan="3">B. Tech VI Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE504</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Mins</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To learn the basic principles of Web page design.
To learn the basic concepts of HTML.
To introduce client side scripting with Java Script.
To introduce the concepts of CSS and Web publishing.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Define the principle of Web page design and basics in web design.</td></tr>
<tr><td>CO 2</td><td colspan="8">Visualize the basic concept of HTML and recognize the elements of HTML.</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand java Script and create static web pages.</td></tr>
<tr><td>CO 4</td><td colspan="8">Introduce basics concept of CSS.</td></tr>
<tr><td>CO 5</td><td colspan="8">Develop the concept of web publishing.</td></tr>
</table>

UNIT – I

Web Design Principles: Basic principles involved in developing a web site, Planning process, Five Golden rules of web designing, Designing navigation bar, Page design, Home Page Layout, Design Concept.

Basics in Web Design: Brief History of Internet, what is World Wide Web, Why create a web site, Web Standards, Audience requirement.

UNIT – II

Introduction to HTML: What is HTML, HTML Documents, Basic structure of an HTML document, Creating an HTML document, Mark up Tags, Heading-Paragraphs, Line Breaks, HTML Tags.

Elements of HTML: Introduction to elements of HTML, Working with Text, Working with Lists, Tables and Frames, Working with Hyperlinks, Images and Multimedia, Working with Forms and controls.

UNIT – III

Java Script: Introduction, Basics of Java Script, Control Structures, Pop up Boxes, Functions,
Arrays Events, Objects, Dynamic HTML.

UNIT – IV

Introduction to Cascading Style Sheets: Concept of CSS , Creating Style Sheet, CSS Properties, CSS Styling(Background, Text Format, Controlling Fonts) , Working with block elements and objects, Working with Lists and Tables, CSS Id and Class , Box Model(Introduction, Border properties, Padding Properties, Margin properties) , CSS Advanced(Grouping, Dimension, Display, Positioning, Floating, Align, Pseudo class, Navigation Bar, Image Sprites, Attribute sector), CSS Color , Creating page Layout and Site Designs.

UNIT – V

Introduction to Web Publishing or Hosting: Creating the Web Site, Saving the site, working on the web site, Creating web site structure, Creating Titles for web pages, Themes-Publishing web sites.

Text Books:

1. Creating a Web Page and Web Site College, 2002, Murray, Tom/Lynchburg.
2. HTML 5 in simple steps Dreamtech Press, Kogent Learning Solutions Inc.
3. A beginner's guide to HTML NCSA,14th May,2003.

Reference Books:

1. HTML, XHTML, and CSS Bible, 5ed, HTML, XHTML, and CSS Bible, 5ed, Wiley India.
2. Beginning HTML, XHTML, CSS, and JavaScript by John Duckett, Wiley India.
3. Beginning CSS: Cascading Style Sheets for Web Design by Ian Pouncey, Richard York, Wiley India.

Course Title	OPERATING SYSTEMS (Open Elective Course – II)					B.Tech. VI Sem (R20UG) AI&ML		
Course Code	Category	Hours / Week			Credits	Maximum Marks		
20OE3903	OEC	L	T	P	C	Continuous Internal Assessment	End Exams	Total
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes						End Exam Duration: 3Hrs		

Course Objectives:
Have an overview of functions of operating systems.
Have a thorough knowledge of process management and memory management.
To have a thorough knowledge of how handle to deadlocks.
Learn the concepts of files, protection and security

Course Outcomes: On successful completion of this course, the students will be able to	
CO1	Understand the basic concepts related to the operating systems
CO2	Analyze the various process scheduling algorithms and process synchronization mechanisms.
CO3	Analyze the various memory management schemes.
CO4	Understand the ways to deal the deadlocks and the basic concepts related to files in the system.
CO5	Analyze the protection and security mechanism.

UNIT – I
Operating Systems Basics: Operating systems functions, Overview of computer operating systems, distributed systems, operating system services and systems calls, system programs, operating system structure.

UNIT – II
Process Management: Process concepts, scheduling-criteria, CPU scheduling algorithms, Evaluation of Scheduling Algorithms.
Concurrency: Process synchronization, the critical-section problem, Peterson's Solution, semaphores, Classic problems of Synchronization, monitors.

UNIT – III
Memory Management: Introduction**,** Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, Allocation of frames.

UNIT – IV
Deadlocks: system model, deadlock characterization, deadlock prevention,detection and avoidance, recovery form deadlock.
Files: The concept of a file, Access Methods, File Allocation Methods.

UNIT – V
Protection: Protection, Goals of Protection, Principles of Protection, Domain of protection AccessMatrix, Implementation of Access Matrix.

Text Books:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Operating System Concepts", Eighth edition, John Wiley.
2. Andrew S Tanenbaum, "Modern Operating Systems", Fourth Edition, Pearson Education.
3. William Stallings, "Operating Systems: Internals and Design Principles", Sixth Edition2009, Pearson Education.
4. D.M. Dhamdhere, "Operating Systems, A Concept based Approach", Third Edition,TMH.

Reference Books:

1. A.S. Godbole, "Operating Systems", Second Edition, TMH.
2. Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition.
3. Operating Systems – H.M. Deitel, P. J. Deitel, D. R. Choffnes, 3rd Edition, Pearson.
4. Operating Systems: A Practical Approach, Rajiv Chopra, 4^{th} Edition, S Chand Publishers.

<table>
<tr><td>Course Title</td><td colspan="4">DATABASE MANAGEMENT SYSTEMS
(Open Elective Course – II)</td><td colspan="4">B.Tech. VI Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE3904</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>ContinuousInternal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To study the physical and logical database designs, database modeling, relational hierarchical, and network models.
To understand and use data manipulation language to query, update, andmanaging the database.
To develop an understanding of essential DBMS concepts such as: database secure integrity and concurrency.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">To understand the basic concepts and the application of Database systems.</td></tr>
<tr><td>CO 2</td><td colspan="8">To understand the basics of SQL and construct queries using SQL.</td></tr>
<tr><td>CO 3</td><td colspan="8">To understand the Relational Database design principles.</td></tr>
<tr><td>CO 4</td><td colspan="8">To apply various Normalization techniques for database design improvement.</td></tr>
<tr><td>CO 5</td><td colspan="8">To apply concurrency control and recovery techniques during transaction execution.</td></tr>
</table>

UNIT – I

Introduction - Database-System Applications, View of Data, Database languages, Database architecture, Database Users and Administrators.
E-R Model - The Entity Relationship Model, Constraints, Entity Relationship Diagrams, and Extended E-R features.

UNIT – II

Relational Model - Structure of Relational Databases, Database Schema, Keys, Query Languages, Fundamental Relational Algebra Operations, Additional Relational Algebra Operations, Extended Relational Algebra Operations, Modification of Database.

UNIT – III

Introduction to SQL - Data Definition, Basic Structure of SQL Queries, Set Operations, Null Values, Aggregate Functions, Nested Sub queries, Complex queries, views, Modification of the Database.
Advanced SQL -Integrity Constraints, Dynamic SQL, Functions and Procedures.
OtherRelational Query Languages - Tuple Relational Calculus, Domain Relational calculus.

UNIT – IV

Normal Forms – Atomic domain and First Normal Form, Keys and Functional Dependencies, Second Normal Form, BCNF, BCNF and Dependency Preservation, Third Normal Form, Lossless Decomposition, Dependency- preserving, Multi valued Dependencies, Fourth Normal Form, Join Dependencies, Fifth Normal Form, and Inclusion dependencies.

UNIT – V

Transactions -Transaction Concept, Transaction State, Implementation of Transaction Atomicity and Durability, Concurrent Executions, Serializability.
Concurrency Control -Lock-Based Protocols, Timestamp-Based Protocols.
RecoverySystem - Failure Classification, Storage, Recovery and Atomicity, Log based recovery.

Text Books:

1. Abraham Silberschatz, Henry F. Korth, S. Sudarshan,” Database system Concepts”, 5thEdition, McGrawhill.
2. Ramez Elmasri, Shamkant B. Navathe, "Fundamental Database Systems", Pearson Education, 3rd Edition, 2003
3. C.J.Date, “Introduction to Database”, 8 Th Edition, 2003, Addison-Wesley publication.
4. Hector Garcia Molina, Jeffrey D. Ullman, Jennifer Widom, "Database System Implementation", Pearson Education, United States 1st Edition, 2000

Reference Books:

1. Raghurama Krishnan, Johannes Gehrke, Data base ManagementSystems.3rd Edition, Tata McGrawHill.
2. Peter Rob, Ananda Rao and Carlos Corone, Database Management Systems,Cengage Learning, 1st Edition, 2011.
3. Thomas Connolly, Carolyn Begg, Database Systems: A Practical Approach to Design, Implementation and Management,6th Edition,2012.
4. S.K.Singh, “Database Systems Concepts, Design and Applications”, First Edition, Pearson
5. Education, 2006.

<table>
<tr><td>Course Title</td><td colspan="4">MATHEMATICAL STATISTICS FOR DATA SCIENCE & DATA ANALYTICS (R20)</td><td colspan="4">B. Tech.
Open Elective-II</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE603</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 minutes</td><td colspan="4">End Exam Duration: 3Hours</td></tr>
<tr><td colspan="9">Course Objectives:
To help the students in getting a thorough understanding of the fundamentals of probabilities.
To help the students in getting a thorough understanding and usage of statistical techniques like testing of hypothesis.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand and calculate the measures of dispersion</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze probability concepts</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply distributions in real life problems.</td></tr>
<tr><td>CO 4</td><td colspan="8">Justify hypothesis concepts</td></tr>
<tr><td>CO 5</td><td colspan="8">Estimate correlation and regression coefficients</td></tr>
</table>

UNIT 1:
Introduction, Mean, Median, Mode, Skewness, Range

UNIT II:
Probability Basics, Simple probabilities, Rule of addition, Rule of multiplication, Conditional Probability, Baye's theorem.

UNIT III:
Explaining basic concepts of Random Variables (Without Problems)- Probability Distributions: Binomial distribution**,** Poisson distribution**,** Normal distribution**,** Real life problems

UNIT IV:
Introduction, Hypothesis, Level of Significance, Type I and Type II errors, Confidence intervals for large Samples (only means and Proportions), Calculating sample size and power.

UNIT V:
Introduction, Linear Regression, Correlation coefficient, Coefficient of determination, Root Mean Square Error.

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-42 edition.
2. Statistical Methods by S.P.Gupta, S Chand Publications

3. Probability and Statistics for Engineers, Johnson, Fifth edition, Prentice Hall of India.
4. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 9^{th} edition- 2013.

Reference Books:

1. Probability and Statistics by E. Rukmangadachari & E. Keshava Reddy, Pearson Publishers.
2. Probability and Statistics for Engineers and Scientists, Walpole and Myers, Seventh edition, Pearson Education Asia, 2002
3. An Introduction to Probability theory and its applications, William Feller
4. Engineering Mathematics by Srimanta Pal, Subodh C. Bhunia, Oxford University Press.

Course Title	**BASICS OF ELECTRICAL, MAGNETIC AND OPTOELECTRONIC MATERIALS**	**OPEN ELECTIVE- II**

Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE608	**BSC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End lab Exams**	**Total**
		3	**0**	**0**	**3**	40	60	100
					End Exam Duration: 3Hrs			

COURSE OBJECTIVES:

1.Students will be able to understand the fundamental concepts and applications of electrical, magnetic and optical properties of materials.
2.Apply a multi-disciplinary approach to plan, design, identify and address future needs of all the conventional and novel materials utilizing their properties for the society.

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

CO1	**Obtain** knowledge about the electrical, magnetic and optoelectronic materials, their properties and applications
CO2	Successfully **apply** advanced concepts of materials engineering for the design, development and analysis of materials and devices.
CO3	**Develop** novel materials from the fundamental understanding of materials and apply them to societal needs.
CO4	**Analyze** the properties of superconductors.
CO5	**Identifies** the Engineering applications of electrical, magnetic and optoelectronic materials.

Unit – I: Electrical Materials
Introduction to electrical conduction–Dielectric constants – dielectric loss, dielectric breakdown, piezoelectricity and pyroelectricity.

Unit – II: Magnetic Materials
Introduction to dia, para, ferro, antiferro and ferri magnetism –Hysteresis loop–hard and soft magnetic materials- applications

Unit – III: Semiconducting Materials
Introduction to semiconducting materials – concept of doping – working principle of p-n junction diode, LED, Photo diode– solar cell – applications.

Unit – IV: Superconducting

Introduction to superconductors-Properties-Meissner effect-Type-1 &Ttype-II superconductors –BCS theory- high critical temperature (Tc)-applications.

Unit – V: Optoelectronic Materials

Introduction to Laser Principles – ruby, CO_2 lasers – applications of optoelectronic materials – introduction to optical fibers – light propagation –Fiber optic sensors-applications.

Text Books:

1. C. Kittel, Introduction to Solid State Physics, John Wiley and Sons, 7th edition,New Delhi, (2004).
2. Engineering Physics – K. Thyagarajan, McGraw Hill Publishers
3. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Kshirsagar, S. Chand and Company

Reference Books:

1. V. Raghavan, Materials Science and Engineering, Prentice Hall of India, 5th edition, New Delhi, (2013).
2. B. G. Yacobi, Semiconductor Materials: An Introduction to Basic Principles, Springer, 1st edition, New York, (2013).
3. S. Kasap and P. Capper (eds.), Handbook of Electronic and Photonic Materials, Springer, New York, (2007).

<table>
<tr><td>Course Title</td><td colspan="5">Corrosion and Control</td><td colspan="3">B. Tech.
(Open elective-II)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE609</td><td rowspan="2">Open Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To review the fundamental aspects of electrochemistry.
It also focuses on various forms of corrosion, and their impact on life of metallurgical components, means and ways to engineer corrosion</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Recall the concepts of corrosion and its mechanism.</td></tr>
<tr><td>CO 2</td><td colspan="8">Explore different forms of corrosion and its mechanisms & prevention methods.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze different factors which influence corrosion in different medium</td></tr>
<tr><td>CO 4</td><td colspan="8">Identify different control methods for efficient control of corrosion</td></tr>
<tr><td>CO 5</td><td colspan="8">Discuss corrosion aspects which will enable them to apply for modern engineering technology</td></tr>
</table>

Unit-1: Introduction
Introduction to corrosion, definition and types of Corrosion (Chemical- & Electrochemical Corrosion-Evolution of Hydrogen gas & Absorption of Oxygen) & its mechanisms, Pilling Bed worth Rule , Galvanic series & its applications, Factors influencing corrosion-Metal & environment..

Unit-2: Corrosion& Various phenomenon
Uniform Corrosion (definition, mechanism & prevention), Galvanic (Two-metal) Corrosion (Definition, mechanism & prevention), Pitting corrosion (Definition, mechanism & prevention), Concentration Cell Corrosion (Definition, mechanism & prevention),Differential aeration method (Definition, mechanism & prevention)

Unit-3: Environmental Factors on Corrosion
Various factors that influence Corrosion- Corrosion in water and aqueous solution, microbiologically induced corrosion, corrosion in acidic and alkaline medium.

Unit-4: Prevention & Control
Basic principle & concepts of prevention of corrosion-Cathodic protection (Sacrificial anodic protection, Impressed current Cathodic protection), Electroplating & Electroless plating-Definition with examples (Nickel & Copper), advantages - Alternation of Environment.

Unit-5: Modern theory and applications of corrosion:

Introduction, Gibb’s free energy, cell potentials, EMF series, Corrosion rate expressions, Importance of corrosion in engineering technology & industrial applications.

Textbooks:

1. Text Book of Engineering Chemistry, Shashi Chawla, Dhanapath Rai Publications, New Delhi, 4th Edition, 2011.
2. Corrosion of metals, Helmut Kaesche, Springer Publications
3. Handbook of Corrosion Engineering, 3^{rd} edition, Pierre R. Roberg, McGraw Hill publications
4. General Chemistry for Engineers, Jeffrey S. Gaffney & Nancy A. Marley, Elsevier publications

REFERENCES:

1. Corrosion engineering, Fontana Mars G, Mc Graw Hill publications
2. A Text Book of Engineering Chemistry, Jain and Jain, Dhanapath Rai Publishing Company, New Delhi, 15th Edition, 2010
3. Corrosion and chemical resistant masonry materials Handbook, Walter T.V. Sheppard Lee, Building materials series.
4. General chemistry by Ebbing Darrell, Himalaya Publications

Course Title	Academic Writing				OPEN ELECTIVE – III		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE615	**HUM**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

COURSE OBJECTIVES	
1	Demonstrate and apply knowledge of basic essay structure, including introduction, body and conclusion;
2	Employ the various stages of the writing process, including pre-writing, writing and re-writing
3	Identify effective writing techniques in his or her own work and in peer writing.
4	Improve academic and idiomatic vocabulary;
5	Understand the importance of academic writing and avoid the plagiarism
COURSE OUTCOMES	
CO1	Engage with readings critically by evaluating the various contexts (social, historical, or personal) surrounding and underpinning each text
CO2	Effectively summarize and analyze various texts while identifying and highlighting their main ideas and messages
CO3	Develop independent perspectives and arguments via persuasive support and successful incorporation of research thus developing their own voice and creating a balance between their own voice and source summaries
CO4	Practice the revision skills necessary for the accomplishment of a writing project
CO5	Constructively critique their own and peers' writing, with an awareness of the collaborative and social aspects of the writing process

UNIT 1
Academic Writing
Definition- Difference between Academic and Non-academic writing – Four types of academic writing – The 4Cs of Academic Writing- Essentials of a well-structured academic writing- (Introduction, Explanation, Illustration and Conclusion)

UNIT 2
Paragraph structure
Topic sentence - supporting examples - transition sentence- Basic rhetorical modes Narration- description – exposition

UNIT 3
Writing Process and strategy
Writing Process and strategy research, planning, summarizing, organizing, plagiarism, referencing, proofreading

UNIT 4
Structure of research paper
Structure of research paper (organizing the document, transition, data implementation and display)

UNIT 5

Writing Vocabulary and language

Writing Vocabulary and language (precision, clarity, conciseness, academic vocabulary, word choice)

Text Books:

1. Hairston, et al. The Scott, Foresman Handbook for Writers (San Francisco: Longman
2. 2002 or latest edition)
3. Stephen Bailey Academic Writing: A Handbook for International Students

Reference Books:

1. A Short Guide to College Writing, 5th edition, by Barnet, Bellanca, and Stubbs.
2. Power of Habit by Charles Duhigg. Random House Trade Paperbacks. ISBN: 978-0-8129-8160-5. Available at the IVC bookstore. You MAY use hard copy or digital version.
3. Writing Clearly: Grammar for Editing 3rd Ed. by Janet Lane & Ellen Lange. Heinle Cengage Learning, 2012 ISBN 978-1-111-35197-7. Available at the IVC bookstore.

<table>
<tr><td>Course Title</td><td colspan="4">Basics of Financial Management for Engineers</td><td colspan="3">B. Tech.
Open Elective - II</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE611</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Min</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objective:
Provide an in-depth view of the process in financial management.
Develop knowledge on the allocation, management and funding of financial
resources.
Improving students' understanding of the time value of money concept and the role of a financial manager in the current competitive business scenario.
Enhancing student's ability in dealing short-term dealing with day-to-day working capital decision; and also longer-term dealing, which involves major capital investment decisions and raising long-term finance.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Knowledge of the basics of Financial Management Concepts.</td></tr>
<tr><td>CO 2</td><td colspan="8">To learn the concept of cost of capital and making decisions regarding raising of capital</td></tr>
<tr><td>CO 3</td><td colspan="8">To understand the concept of Capital structure evaluation and related decisions.</td></tr>
<tr><td>CO 4</td><td colspan="8">To build knowledge about financing and estimation of Working capital management.</td></tr>
<tr><td>CO 5</td><td colspan="8">To understand the concepts of TVM, capital budgeting decisions and evaluation of Projects.</td></tr>
<tr><td>CO 6</td><td colspan="8">Understanding of mergers, acquisitions and various other types financial restructurings</td></tr>
</table>

Unit I

Introduction to Financial Management - Concept of Business Finance, Functions of Finance, scope of Finance, Role of a Finance Manager, Goals, objectives of Financial Management, Functional areas.

Unit II

Cost of Capital - Long Term sources of finance, Concept, meaning & importance, Opportunity Cost of capital, Cost of different sources of finance, Weighted average cost of capital, factors affecting cost of capital.

Unit III

Budgeting: budgets, purpose, budgetary control, preparation of budgets, master budget, fixed and flexible
Budgeting.

Unit IV

Working Capital Management - Concept of working capital, significance, types of working capital, Factors affecting working capital needs, financing approaches for working capital, working capital estimation and calculation.

Unit V

Capital Budgeting Decision - Time Value of Money, Capital budgeting - Introduction, techniques of capital budgeting -Pay Back Method, Accounting Rate of Return, Net Present Value, Profitability Index, and Internal Rate of Return.

Text Book:

1. Financial Management by Dr. R. P. Rustagi, Taxmann's Publication.
2. Financial Management: Principles and Applications by Pearson Education; Thirteenth edition, Sheridan Titman,
3. Financial Management by I M Pandey, Pearson Education; Twelfth edition.
4. Fundamentals of Financial Management by Eugene F. Brigham, Joel F. Houston, Brigham Houston, seventh edition.
5. Financial Management Theory and Practice by Michael C. Ehrhardt and Eugene F. Brigham, Publisher, Joe Sabatino.

Reference Books:

1. Financial Management: Theory & Practice by Eugene F. Brigham and Michael C. Ehrhardt; Cengage Learning; 15 editions.
2. Fundamentals of Financial management by Dr. Eugene Brigham and Dr. Joel F.Houston: Cengage learning, Philippine Edition.
3. Financial Management Principles and practice by G. Sudarsana Reddy, Himalaya Publishing House.
4. Financial Management by Khan & Jain, Tata Mcgraw Hill.
5. Financial Management by Dr. P C Tulsian, S Chand.
6. Financial Management by Ravi Kishore, Taxmann.

<table>
<tr><td>Course Title</td><td colspan="5">Power Electronics Lab</td><td colspan="3">B.Tech VI SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002607</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the characteristics of MOSFET and IGBT, force commutated circuits, output voltage of single phase half and fully controlled rectifiers, ac voltage controllers. Design and simulation of three phase half and fully controlled rectifiers, PWM inverter using MATLAB.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the characteristics of MOSFET and IGBT, forced commutation circuits.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the output voltage performance of single phase half and fully controlled rectifiers with R and RL loads.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the output voltage performance of AC voltage controller, cyclo converter with R and RL loads.</td></tr>
<tr><td>CO 4</td><td colspan="8">Design and simulate the three phase rectifier and PWM inverter using MATLAB.</td></tr>
</table>

List of the experiments (Any Eight)

Study of characteristics of MOSFET & IGBT
Single Phase AC Voltage Controller with R and RL Loads
Single Phase fully controlled bridge converter with R and RL loads
Forced Commutation circuits (Class A, Class B, Class C, and Class D & Class E)
DC Jones chopper with R and RL Loads
Single Phase Parallel, inverter with R and RL loads
Single Phase Half controlled converter with R load
Single Phase Dual converter with RL loads
MATLAB simulation of single-phase full converter using RLE loads and single-phase AC voltage controller using RLE Loads
MATLAB simulation of single phase inverter with PWM control

<table>
<tr><td>Course Title</td><td colspan="5">Power Systems – II Lab</td><td colspan="3">B.Tech VI SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002608</td><td rowspan="2">Professional Core (PCC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to identify & formulate solutions to problems relevant to power systems using software tools.</td></tr>
<tr><td colspan="9">On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the concept of MATLAB programming and ETAP in solving power systems problems.</td></tr>
<tr><td>CO 2</td><td colspan="8">Acquire knowledge on formation of Bus Admittance matrix.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the power flow using GS, NR method and DC load flow method.</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze various fault studies on the power system.</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand power system planning and operational studies.</td></tr>
</table>

List of Experiments (Any Eight)

Modeling of a Transmission Line with Lumped Parameters
Formation of Y-bus for a given power system network
AC Load flow analysis of a simple 3-bus system using Gauss Seidel method
AC Load flow analysis of a simple 3-bus system using Newton Raphson method
Study on D C Load Flow
Study on Economic Load Dispatch
Short circuit analysis
Simulation of single area load frequency control system
Simulation of Automatic Voltage Regulator
Tripping characteristics of Fuse & MCB
Tripping sequence of protective devices
Characteristics of over current relay

Note: All the above experiments are simulated by using MATLAB/ETAP Software

<table>
<tr><td>Course Title</td><td colspan="4">Advanced Programming Lab</td><td colspan="4">B.Tech VI SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2004609</td><td rowspan="2">Engineering Science Course (ESC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>0</td><td>0</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6"></td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn, write, test and debug simple LABVIEW Programs.</td></tr>
<tr><td colspan="9">On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand, test and debug simple Programs</td></tr>
<tr><td>CO 2</td><td colspan="8">Demonstrate operations on arrays and strings</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply conditional statements</td></tr>
<tr><td>CO 4</td><td colspan="8">Make use of Sub VI’s for structuring Programs</td></tr>
<tr><td>CO 5</td><td colspan="8">Make use of Read and write data from/to files</td></tr>
</table>

List of Programs (Any Eight)

Basic arithmetic operations (Add, mul, div, compound arithmetic, expression node, express formula and formula node)
Boolean operations (truth table verification of logic gates, Half Adder and Full Adder, convert binary to decimal value, convert BCD to Gray and Vice-Versa)
String operations (Length, concatenation, insert string, sub-string, replace string, reverse string, rotate string, etc)
Sum of ‘N’ numbers using feedback loop (use ‘for ’ loop and ‘while’ loop)
Factorial of a give number using shift register (use ‘for’ loop and ‘while’ loop)
Generate Fibonacci series for N iteration (use ‘for’ loop)
Create a VI to increase the tank level from 0 to 100 & decrease the value from 100 to 0 using while loop in a single process.
Create a VI to implement and, or & not gates(or arithmetic operations) using case structure .

Build a VI that generates a 1D array of random numbers and sort the array in descending and ascending order and find the following:
Maximum and min value of array elements
Size of the array
Sum and product of array elements
Rotate array by 1 position
Split the array after 2 elements

Build an array of cluster controls in which each cluster consists of a numeric control and 1D numeric array. This forms the database of students. The numeric control indicates the roll no and array indicates the test marks of 4 subjects. Build the logic to modify the mark in a particular subject of a particular student. Input the roll number, subject in which mark is to be changed and new mark. Display the database on a separate array indicator.
Create a VI to implement Full Adder circuit using SubVI.
Any application using Flat and stacked sequence
Software Used: LABVIEW Software for Windows/Linux

Course Title	**Skill Advanced Course (MATLAB – SIMULINK)**					**B.Tech VI SEM EEE (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002610	**Skill Course (SC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		1	**--**	**2**	**2**	**40**	**60**	**100**
						End Exam Duration : 3Hrs		
Course Objectives: The objective of the course is to learn the basic features and fundamental blocks of SIMULINK and to solve electrical engineering problems.								
Course Outcomes: On successful completion of this course, the students will be able to,								
CO 1	Understand basic features of SIMULINK.							
CO 2	Know various signals, operations and user defined functions.							
CO 3	Analyze fundamental blocks of SIM power systems.							
CO 4	Solve Electrical Engineering problems using SIMULINK.							

Module-1

Elementary features: Introduction to Simulink –Creating new Simulink file – Commonly used blocks – Continues & Discrete signals – Logic & Bit operations – Math operations – Ports & Subsystems – Sinks – Sources – User defined functions.

Module-2

SIM Power Systems: Fundamental Blocks: Electrical sources – Elements – Interface elements – Machines – Power Electronics – Control & Measurement- FACTS – Renewable Sources

Module-3

Electrical Engineering Applications – Modeling& Simulation of simple Electrical Block diagrams: Power electronics, Electrical Machines, Power & Control Systems.

Text books

1. Beginning MATLAB and Simulink from Novice to Professional by Sulaymon Eshkabilov, Apress.
2. Modeling & Simulation Using MATLAB – Simulink by Dr. Shailendra Jain, Wiley.
3. MATLAB – Simulink for Engineers by Agam Kumar Tyagi, OXFORD University press.

<table>
<tr><td>Course Title</td><td colspan="5">Management & Organizational Behavior (Mandatory Course)</td><td colspan="3">B.Tech VI SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20MC612</td><td rowspan="2">Humanities & Social Sciences (HSMC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>2</td><td>0</td><td>0</td><td>0</td><td>40</td><td>0</td><td>40</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2Hrs</td><td colspan="3">External Exam Duration:</td></tr>
<tr><td colspan="9">Course Objectives: The main objective of the course is to learn
To aid students in understanding human behavior in organizations,
To provide students with a comprehensive exposure to organizational behavior theories, research and workplace issues.
The course also provides an overview of the theories and practices of management in organizational contexts.</td></tr>
<tr><td colspan="9">Course Outcomes: On success Completion This course, the students will be able to</td></tr>
<tr><td>CO1</td><td colspan="8">Explain the Importance & Role of Management in the Organizations.</td></tr>
<tr><td>CO2</td><td colspan="8">Evaluate the different aspects related to Decision Making and Controlling Process</td></tr>
<tr><td>CO3</td><td colspan="8">Describe the different theories related to Individual behavior in the Organization</td></tr>
<tr><td>CO4</td><td colspan="8">Analyze Group Behavioral influence in the Organization.</td></tr>
<tr><td>CO5</td><td colspan="8">Evaluate the process and climate effects in Organization Behavior.</td></tr>
</table>

UNIT-I

Role of Management:
Concept – Significance – Functions – Principles of Management - Patterns of Management: Scientific – Behavioral – Systems – Contingency.

UNIT-II

Decision Making & Controlling – Process – Techniques. Planning – Process – Problems –– Making It Effective. Controlling - System of Controlling – Controlling Techniques – Making Controlling Effective

UNIT-III

Individual Behavior & Motivation – Understanding Individual Behaviour – Perception – Learning – Personality Types – Johari window- Transactional Analysis- Motivation – Concept of Motivation - Motivational Theories of Maslow, Herzberg, David McClelland, and Porter and Lawler

UNIT-IV

Group Behavior & Leadership: Benefits of Groups – Types of Groups – Group Formation and Development. Leadership and Organizational Culture and Climate: Leadership – Traits Theory – Managerial Grid – Transactional Vs Transformational Leadership – Qualities of good leader- Women Leadership in India.

UNIT-V

Organizational Behavior: Organizing Process – Departmentation Types – Making Organizing Effective – Organizational culture- Types of culture – Organizational Culture Vs Organizational climate - Conflict management - Change Management.

Text Books:

1. Organizational Behavior, Stephen P. Robbins, Pearson Education
2. Management and Organizational Behavior, Subbarao P, Himalaya Publishing House
3. Principles of Management, Koonz, Weihrich and Aryasri, Tata McGraw Hill.

Reference Books:

1. Organizational Behavior, S.S.Khanka, S.Chand
2. Organizational Behavior, Mishra .M.N ,Vikas
3. Management and Organizational behavior, Pierce Gordner, Cengage.
4. Behavior in Organizations, Hiriyappa.B.New Age Publications
5. Organizational Behavior, Sarma, Jaico Publications.
6. Principles of Management ,Murugesan ,Laxmi Publications

B.Tech VII SEM EEE (R20)

Course Title	**POWER QUALITY (PEC – III)**					**B.Tech VII SEM EEE (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002701	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3 Hrs**		
Course Objectives: The student is able to learn the power quality issues, voltage disturbances, power transients, concept of harmonics and their effect in power system equipment, measuring and monitoring concepts of power quality.								
Course Outcomes: On successful completion of this course, the students will be able to								

CO 1	Understand the different power quality problems in the power system.
CO 2	Understand the effect of harmonics in the system and the equipment
CO 3	Examine the voltage variations and over voltage transients and conventional devices for voltage regulations in the system.
CO 4	Analyze the concepts on measuring and monitoring issues of quality.

UNIT-I

Introduction: Definition of Power Quality- Power Quality Terminology – Classification of Power Quality Issues-Magnitude Versus Duration Plot - Power Quality Standards (IEEE & IEC) - Responsibilities of The Suppliers and Users of Electric Power-CBEMA and ITIC Curves.

UNIT-II

Transients, Short Duration and Long Duration Variations: Categories and Characteristics of Electromagnetic Phenomena in Power Systems-Impulsive and Oscillatory Transients-Interruption - Sag-Swell-Sustained Interruption - Under Voltage – Over Voltage–Outage. Sources of Different Power Quality Disturbances- Principles of Regulating the Voltage-Conventional Devices for Voltage Regulation.

UNIT-III

Fundamentals of Harmonics : Harmonic Distortion, Voltage Versus Current Distortion, Harmonics Versus Transients, Power System Quality Under Non Sinusoidal Conditions, Harmonic Indices, Harmonic Sources From Commercial Loads, Harmonic Sources From Industrial Loads.

UNIT-IV

Power Quality Monitoring: Power Quality Benchmarking-Monitoring Considerations-Choosing Monitoring Locations- Permanent Power Quality Monitoring Equipment-Historical Perspective of Power Quality Measuring Instruments- Power Quality Measurement Equipment-Types of Instruments- Assessment of Power Quality Measurement Data- Power

Quality Monitoring Standards.

UNIT-V

Power Quality Enhancement Using Custom Power Devices: Introduction to Custom Power Devices-Network Reconfiguring Type: Solid State Current Limiter (SSCL)-Solid State Breaker (SSB) -Solid State Transfer Switch (SSTS) - Compensating Type: Dynamic Voltage Restorer (DVR)-Unified Power Quality Conditioner (UPQC)-Principle of Operation Only.

Text Books

1. Electrical Power Systems Quality, Roger C. Dugan, Mark F. McGranaghan, Surya Santoso, H. Wayne Beaty, 2nd Edition, TMH Education Pvt. Ltd., 2008.
2. Power quality, C. Sankaran, CRC Press, 2002.

Reference Books

1. Understanding Power quality problems, Math H. J. Bollen IEEE Press, 2007.
2. Power quality enhancement using custom power devices, Arindam Ghosh, Gerard Ledwich, Kluwer academic publishers, 2002.
3. Fundamentals of Electric Power Quality, Surya Santoso, Create Space, 2010.

<table>
<tr><td>Course Title</td><td colspan="5">Electric & Hybrid Vehicles (PEC-III)</td><td colspan="3">B.Tech VII SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002702</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration : 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The main objective of the course is to learn upcoming technology of hybrid systems, different aspects of drives application & electric traction.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand electric drive in vehicles / traction.</td></tr>
<tr><td>CO 2</td><td colspan="8">Evaluate energy efficiency of the vehicle for its drive trains.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze and design of hybrid and electric vehicles.</td></tr>
<tr><td>CO 4</td><td colspan="8">Acquire knowledge about fundamental concepts, principles of hybrid and electric vehicles.</td></tr>
</table>

UNIT - I

Conventional Vehicles: Basics of vehicle performance, vehicle power source characterization, transmission characteristics and mathematical models to describe vehicle performance.

Introduction to Hybrid Electric Vehicles: History of hybrid and electric vehicles, social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

UNIT - II

Hybrid Electric Drive-Trains: Basic concept of hybrid traction, introduction to various hybrid drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

Electric Drive-Trains: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

UNIT - III

Electric Propulsion Unit: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switched Reluctance Motor drives, drive system efficiency.

UNIT - IV

Energy Storage: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices.

UNIT - V

Energy Management Strategies: Introduction to energy management strategies used in hybrid and electric vehicles, classification of different energy management strategies, comparison of different energy management strategies, implementation issues of energy management strategies.

Text Books

1. Hybrid Electric Vehicles: Principles and applications with Practical Perspectives by C. Mi, M. A. Masrur and D. W. Gao, John Wiley & Sons, 2011.
2. Hybrid Electric Vehicles: Energy Management Strategies by S. Onori, L. Serrao and G. Rizzoni, Springer, 2015.

Reference Books

1. Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design by Ehsani, Gao, Gay, Emadi, 2005 by CRC Press.
2. Electric and Hybrid Vehicles by T. Denton, Routledge, 2016.

<table>
<tr><td>Course Title</td><td colspan="5">Power System Reliability
(PEC – III)</td><td colspan="3">B.Tech VII SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002703</td><td rowspan="2">Professional
Elective
(PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2 Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the basic reliability concepts, density and distribution functions, random variables and networks, reliability functions and time dependent reliability evaluation of different networks, markov modelling and component repairable models for frequency and duration and reliability applications to generation, transmission and distribution systems.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the basic reliability concepts, density and distribution functions and network modeling.</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply different reliability functions and time dependent reliability evaluation for different networks.</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand the concepts of markov modeling and component repairable models for frequency and duration techniques.</td></tr>
<tr><td>CO 4</td><td colspan="8">Apply various reliability fundamental techniques to power systems.</td></tr>
</table>

UNIT- I

Basic probability theory: Introduction-rules for combining probabilities of events, Bernoulli's trials, Probability Density and Distribution Functions, Binomial Distribution-Expected Value and Standard Deviation, Problems.

Network Reliability: Analysis of Series, Parallel, Series – Parallel Networks, Complex Networks – Decomposition Method, Problems

UNIT- II

Reliability Functions: Functions – f(t), R(t), F(t), h(t) and their relationships – Exponential Distribution – Expected Value and Standard Deviation – Reliability Analysis of Series – parallel Networks using Exponential Distribution, Problems, Bath – tub Curve – Reliability Measures. MTTF, MTTR, MTBF.

UNIT -III

Markov Modeling

Discrete Markov Chains – Concept of STPM, Evaluations of Limiting State Probabilities, Problems.

Continuous Markov Process: Single component repairable model – Time Dependent Probabilities - Evaluation by using Laplace Transform and STPM Approach – Two Component Reliability Models - evaluation of LSP's using STPM Approach.

Frequency and Duration Concept: Evaluation of Frequency of Encountering State, Mean Cycle Time for One and Two Component Repairable Models.

Evaluation of Cumulative Probability and Cumulative Frequency of Encountering of Merged

States, Problems

UNIT- IV

Generation System Reliability Analysis: Reliability Model of a Generation System, Recursive Relation for Unit Addition and Removal, Load Modeling, Problems.
Two-level representation of daily load, Merging of Generation with Load Model – Evaluation of Transition Rates for Merged State Model - LOLP, LOLE, Problems.

UNIT -V

Composite System Reliability Analysis: System and Load Point Reliability Indices, Weather Effects on Transmission Lines - Weighted Average Rate and Markov Model.
Distribution System Reliability Analysis: Basic Reliability Indices for Radial Networks, Performance Indices - Customer Oriented, Load and Energy Oriented Indices, problems

Text Books:

1. Reliability Evaluation of Engg. System – R. Billinton, R. N. Allan, Plenum Press, New York, Reprinted in India by B. S. Publications, 2006.
2. Reliability Evaluation of Power Systems – R. Billinton, R. N. Allan, Plenum Press, New York, Reprinted in India by B. S. Publications, 2006.

Reference Books

1. System Reliability Concepts by V. Sankar, Himalaya Publishing House, 2015.
2. Reliability Engineering by E. Balagurusamy, Tata McGraw Hill, 2003.

<table>
<tr><td>Course Title</td><td colspan="5">Power Electronics For Renewable Energy Systems (PEC – IV)</td><td colspan="3">B.Tech VII SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002704</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2 Hrs</td><td colspan="3">End Exam Duration : 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To create awareness on various non-conventional energy sources
• To understand role of power converters for solar PV systems
• To gain knowledge on wind energy conversion systems
• To know the grid connection and its issues
• To attain knowledge on importance of hybrid power systems</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
</table>

CO 1	Understand the various Non-Conventional sources of energy.
CO 2	Acquire knowledge on various power converters for Solar energy system.
CO 3	Analyze the Power converter utilized by the wind energy conversion system.
CO 4	Understand the concepts of grid connection and its issues.
CO 5	Recognize the hybrid operation of wind and PV systems and features of MPPT tracking

UNIT- I

INTRODUCTION TO RENEWABLE ENERGY RESOURCES

World and Indian energy scenario - Wind, Solar, Hydro, and Geothermal: Availability and Power extraction - Environmental impacts of Renewable energy sources.

UNIT- II

POWER CONVERTERS FOR SOLAR PV SYSTEM

Solar Photovoltaic System – P-V and I-V Characteristics –Different factors affecting PV output-Necessity of MPPT's- different types of MPPT- Buck, Boost, buck-boost converters - Isolated and Non isolated converters -Standalone PV system – Solar PV system calculation for specific applications- Battery Charging- Charge Controllers.

UNIT- III

POWER CONVERTERS FOR WIND ENERGY SYSTEM

Wind Energy Conversion System - Power Converters for Wind: AC voltage Controller - Matrix converter – Bi directional converter- flyback converter - Standalone operation of fixed and variable speed wind energy conversion systems - Static Kramer Drive for DFIG – Static Scherbius using cycloconverters for DFIG – Rating of Converter for WECS

UNIT- IV

GRID CONNECTED SYSTEM

Grid interface - Grid connection issues: leakage current, Islanding, harmonics, Active /

reactive Power feeding, unbalance Grid Interactive inverter: Line Commutated Inverter – Self Commutated Inverter – Selection of inverter – Rating of Inverters for Grid connected System.

UNIT- V

HYBRID ENERGY SYSTEM

Need for hybrid systems- Range and type of Hybrid systems- Case studies of Wind and PV system – PV-Diesel System – Wind-Diesel Hybrid System – Energy Storage Devices for Hybrid Energy System - Maximum Power Point Tracking (MPPT) - MPPT schemes.

Text Books:

1. Sudipta Chakraborty, Marcelo G. Simes, and William E. Kramer, "Power Electronics for Renewable and Distributed Energy Systems: A Sourcebook of Topologies, Control and Integration", Springer Science & Business, 2013.
2. Nicola Femia, Giovanni Petrone, Giovanni Spagnuolo, Massimo Vitelli, "Power Electronics and control for maximum Energy Harvesting in Photovoltaic Systems", CRC Press, 2013.

Reference Books:

1. Rashid .M. H "Power electronics Hand book", Academic press, 2001.
2. Ion Boldea, "Variable speed generators", Taylor & Francis group, 2006.
3. Rai. G.D, "Non conventional energy sources", Khanna publishes, 2009.
4. Gray, L. Johnson, "Wind energy system", Prentice Hall INC, 1995. 5. B.H.Khan, "Non-conventional Energy sources", Tata McGraw-Hill Publishing Company, New Delhi, 2017.

Course Title	**Electrical Distribution Systems (PEC – IV)**					**B.Tech VII SEM EEE (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002705	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		

Course Objectives: The student is able to learn load modeling characteristics, classification of distribution systems and various substations, improvement of power factor in substations and distribution automation.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand The Concept of Load Characteristics, SCADA, Distribution Automation Systems.
CO 2	Classify Various Loads In Distribution Systems And Substations.
CO 3	Estimate Voltage and Current In Feeders.
CO 4	Analyze Distribution Feeder Configurations, Bus bar Arrangements In Substations.
CO 5	Analyze Voltage Drop and Power Loss Calculations for Radial Networks and Power Factor Improvement.

UNIT- I

Load Modeling and Characteristics: Introduction to Distribution Systems, Load Modeling and Characteristics. Coincidence Factor, Contribution Factor Loss Factor - Relationship between the Load Factor and Loss Factor. Classification of Loads (Residential, Commercial, Agricultural and Industrial) and Their Characteristics.

UNIT-II

Classification of Distribution Systems: Classification of Distribution Systems - Comparison of DC Vs AC–comparison of Under-Ground Vs Over - Head Distribution Systems- Requirements and Design Features of Distribution Systems-

Design Considerations of Distribution Feeders: Radial and Loop Types of Primary Feeders,-Voltage Levels, Feeder Loading, Basic Design Practice of the Secondary Distribution System.

Voltage Drop & Current Calculations (Numerical Problems) in D.C. Distributors.

UNIT-III

Substations: Location of Substations, Rating of Distribution Substation, Service Area within Primary Feeders. Benefits Derived Through Optimal Location of Substations.

Classification of Substations: Air Insulated & Gas insulated Substations, Substation Layouts and functioning of different components of the substations, Merits & Demerits of GIS over AIS, Busbar arrangements in the Sub-Stations with Relevant Diagrams.

UNIT-IV

Power Factor Improvement: Voltage Drop and Power-Loss Calculations: Derivation for Voltage Drop and Power Loss in Lines, Manual Methods of Solution for Radial Networks, Three Phase Balanced Primary Lines.

Causes of Low P. F -Methods of Improving P. F -Phase Advancing and Generation of Reactive KVAR Using Static Capacitors-Most Economical P.F. for Constant KW Load and Constant KVA Type Loads, Numerical Problems.

UNIT-V

Distribution Automation: Distribution Automation (DA) – Project Planning – Definitions – Communication – Sensors – Supervisory Control and Data Acquisition (SCADA) – Consumer Information Service (CIS) – Geographical Information System (GIS) – Automatic Meter Reading (AMR) – Automation Systems.

Text Books:

1. Electric Power Distribution System, Engineering by Turan Gonen, Mc Graw-hill Book Company, 1986.
2. Electric Power Distribution by A. S. Pabla, Tata Mc Graw-hill Publishing Company, 4th edition, 1997.

Reference Books:

1. Electrical Power Distribution Systems by V. Kamaraju, Jain Book Depot. 2012.
2. HandBook of Electric Power Distribution by G. Ramamurthy, 2nd Edition, Universities Press, 2009.

Course Title	Smart Grid (PEC – IV)					B.Tech VII SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002706	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The student is able to learn fundamentals, Architecture and analysis of smart grid with communication, networking and measuring technologies involved in it.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand the features, fundamental components and architecture of smart grid.							
CO 2	Explain information, communication and networking technologies involved with the smart grid.							
CO 3	Explain operation and importance of PMU, WAMPS and smart storage systems in smart grid.							
CO 4	Analyze Microgrid with various concepts and challenges in future.							

UNIT-1

Introduction to Smart Grid: Working definitions of Smart Grid and Associated Concepts – Need of Smart Grid – Smart Grid Functions – Opportunities & Barriers of Smart Grid - Conventional Power Grid and Smart Grid -Concept of Resilient & Self-Healing Grid.

UNIT-II

Smart Grid Architecture: Components and Architecture of Smart Grid – Review of Proposed Architectures for Smart Grid – The Fundamental Component of Smart Grid Designs – Transmission Automation – Distribution Automation –Renewable Integration.

UNIT-III

Information and Communication Technology: Smart sensors, Wired and wireless communication Technology, Network Structures (**HAN, LAN, NAN, WAN**), Introduction to Smart Meters – Advanced Metering Infrastructure (AMI).

UNIT-IV

Smart Grid Technologies: Geographic Information System (GIS) - Intelligent Electronic Devices (IED) - Smart storage like Battery- SMES - Pumped Hydro - Compressed Air Energy Storage - Wide Area Measurement System (WAMS) – SCADA - Phasor Measurement Unit (PMU).

UINT – V

Micro grids and Distributed Energy Resources: Concept of micro grid, need & application of micro grid, formation of micro grid, Issues of interconnection, protection & control of micro grid, Plastic & Organic solar cells, thin film solar cells, Variable speed wind generators, and fuel cells.

Text Books:

1. Janaka Ekanayake, Kithsir iLiyanage, Jian zhong. Wu, Akihiko Yokoyama, Nick Jenkins, “Smart Grid: Technology and Applications”- Wiley, 2012.
2. Stuart Borlase, Smart Grids, Infrastructure, Technology and Solutions, CRC Press, 1e, 2013.

Reference Books:

1. James Northcote, Green, Robert G. Wilson “Control and Automation of Electric Power Distribution Systems (Power Engineering)”, CRC Press.
2. Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability”, Artech House Publishers July 2011.
3. Clark W Gellings, “The Smart Grid, Enabling Energy Efficiency and Demand Side Response”- CRC Press, 2009.
4. James Momoh, “Smart Grid: Fundamentals of Design and Analysis”- Wiley, IEEE Press, 2012.

<table>
<tr><td>Course Title</td><td colspan="4">Flexible AC Transmission Systems
(PEC – V)</td><td colspan="3">B.Tech VII SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002707</td><td rowspan="2">Professional
Elective
(PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is to learn the fundamentals of FACTS controllers, types of FACTS controllers, voltage source converters, shunt and series compensation, control of STATCOM and SVC.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the operating principles of various FACTS devices.</td></tr>
<tr><td>CO 2</td><td colspan="8">Choose proper controllers for specific application based on system requirement.</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand the importance of compensation methods in power system network.</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze the role of SVC & STATCOM in improving the power system dynamics.</td></tr>
<tr><td>CO 5</td><td colspan="8">Analyze the use of control schemes of TCSC, TSSC, GSC in improving the power quality.</td></tr>
</table>

UNIT - I

FACTS Concepts: Transmission interconnections, power flow in an AC system, loading capability limits, Dynamic stability considerations, importance of controllable parameters, basic types of FACTS controllers, benefits from FACTS controllers.

UNIT - II

Voltage Source Converters: Single & three phase full wave bridge Converters -transformer connections for 12 pulse 24 and 48 pulse operation. Three level voltage source converter, pulse width modulation converter, basic concept of current source Converters, and comparison of current source converters with voltage source converters.

UNIT - III

Static Shunt Compensation: Objectives of shunt compensation, midpoint voltage regulation voltage instability prevention, improvement of transient stability, Power oscillation damping. Methods of controllable VAR generation, variable impedance type static VAR generators, switching converter type VAR generators, hybrid VAR generators.

UNIT - IV

Static VAR Compensator(SVC) and Static Synchronous Compensation(STATCOM): The regulation and slope transfer function and dynamic performance, transient stability enhancement and power oscillation damping operating point control and summary of compensator control.

UNIT - V

Static Series Compensators: concept of series capacitive compensation, improvement of transient stability, power oscillation damping.

Functional requirements, GTO thyristor controlled Series Capacitors (GSC), Thyristor Switched Series Capacitor (TSSC) and Thyristor Controlled Series Capacitor (TCSC) control schemes for GSC, TSSC and TCSC.

Text Books:

1. Concepts and Technology of Flexible AC Transmission Systems-Understanding FACTS by Narain G. Hingorani and Laszlo Gyugyi, Standard Publishers Distributors, IEEE Press Publications, 1st Edition, 2001.
2. FACTS Controllers in Power Transmission & Distribution by K. R. Padiyaar, New Academic Science Publishers, 2020.

Reference Books

1. Thyristor based FACTS Controllers for Electrical Transmission Systems by R. Mohan Mathur, Rajiv K. Varma, IEEE Press Series on Power Engineering, 2002.
2. Flexible AC Transmission Systems by Yong Hua Song and Alln T Johns, The Institute of Electrical Engineers, London, UK, 1999.

<table>
<tr><td>Course Title</td><td colspan="5">Industrial Automation & Control (PEC – V)</td><td colspan="3">B.Tech VII SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002708</td><td rowspan="2">Professional Elective (PEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2 Hrs</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The student is able to learn Automation is playing a key role in Industries. Industries rely heavily on automation for economic viability and mass production. It is important for the students to learn the basics of automation, how systems work and the importance of PLC, SCADA and robots in automation. This course will provide an opportunity to learn industrial automation techniques.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand various automation components and systems</td></tr>
<tr><td>CO 2</td><td colspan="8">Draw block diagram of industrial automation and control system</td></tr>
<tr><td>CO 3</td><td colspan="8">Explain architecture of industrial automation system</td></tr>
<tr><td>CO 4</td><td colspan="8">Measure industrial parameters like temperature, pressure, force, displacement, speed, flow, level, humidity and pH.</td></tr>
</table>

UNIT – I

Introduction: Automation overview, Requirement of automation systems, Architecture of Industrial Automation system, Introduction of PLC and supervisory control and data acquisition (SCADA)-Types of Protocols-Substation automation system IEC61850 protocol-Process bus based Substation automation system

UNIT - II

Automation components: Sensors for temperature, pressure, force, displacement, speed, flow, level, humidity and pH measurement. Actuators, process control valves, power electronics devices DIAC, TRIAC, power MOSFET and IGBT. Introduction of DC and AC servo drives for motion control.

UNIT – III

Computer aided measurement and control systems: Role of computers in measurement and control, Elements of computer aided measurement and control, man-machine interface, computer aided process control hardware, process related interfaces, Communication and networking, Industrial communication systems, Data transfer techniques, Computer aided process control software, Computer based data acquisition system, Internet of things (IoT) for plant automation.

UNIT –IV

Programmable logic controllers: Programmable controllers, Programmable logic controllers, Analog digital input and output modules, PLC programming, Ladder diagram, Sequential flow chart, PLC Communication and networking, PLC selection, PLC Installation, Advantage of using PLC for Industrial automation, Application of PLC to process control industries.

UNIT – V

Distributed Control System: Overview of DCS, DCS software configuration, DCS communication, DCS Supervisory Computer Tasks, DCS integration with PLC and Computers, Features of DCS, Advantages of DCS.

Text Books:

1. Industrial Instrumentation and Control By. S.K. Singh The McGraw Hill Companies
2. Process Control Instrumentation Technology By. C.D. Johnson, PHI

Reference Books:

1. Groover, Mikell. P: Automation, Production systems and Computer integrated Manufacturing –Prentice hall India-2004.
2. Mark W Spong& M Vidyasagar: Robot Dynamics and Control, John Wiley & Sons, 1989
3. Robert J Schilling: Fundamentals of Robotics, Analysis and Control. Printice Hall of India 1996
4. R.K. Mittal and I.J. Nagarath: Robotics and Control, TMH-2003.
5. Industrial Instrumentation, Control and Automation, S. Mukhopadhyay, S. Sen and A.K. Deb, Jaico Publishing House, 2013
6. Programmable logic controller, Dunning, Delmar.

Course Title	**Distributed Generation & Micro Grid (PEC – V)**					**B.Tech VII SEM EEE (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002709	**Professional Elective (PEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 2 Hrs						**End Exam Duration : 3Hrs**		
Course Objectives: The student is able to learn about different distributed generations, energy storage devices and Micro grid systems and Understanding the concepts of system development and relevant issues.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand the synchronization and other distributing resources such as energy storage and fuel cell.							
CO 2	Understanding of the microgrid types and configurations.							
CO 3	Applications of power electronics in Micro grid and acquire the knowledge of multifunction grid connected converters.							
CO 4	Analyze the various types of control in micro grid in islanded and grid connected operation.							

UNIT - I

Introduction to Distributed Generation: DG Units - Micro turbines, reciprocating engines, wind generators, photovoltaic generators, fuel cells, biomass, and tidal sources - Need for Distributed generation, renewable sources in distributed generation, current scenario in Distributed Generation, Planning of DGs – Sitting and sizing of DGs – optimal placement of DG sources in distribution systems.

UNIT - II

Grid integration of DGs: Synchronization - Different types of interfaces - Inverter based DGs and rotating machine based interfaces - Aggregation of multiple DG units - Distributed resources to electric power systems: IEEE 1547. Energy storage elements: Batteries, ultra-capacitors, flywheels.

UNIT - III

Economics and Regulatory Aspects of DGs: Selection of sources, regulatory standards/ framework, Standards for interconnecting DG installation classes, security issues in DG implementations. Economic and control aspects of DGs –Market facts, issues and challenges - Limitations of DGs.

UNIT - IV

Introduction to Micro grid: Micro grid Configurations – CERTS Microgrid Test Bed – DC Micro grid- HFAC Micro grid –LFAC – Micro grid – Hybrid DC- and AC- Coupled Micro grid.

Power Electronics in Micro grid: Power Electronics based Microgrid - Grid Connected

Mode – Islanded mode – Battery Charging mode – design of parallel inverters – Microgrid application - Brick Busses Software Framework.

UNIT - V

Control in Micro grid: Impact of load characteristics – Local control – Centralized Control-Decentralized Control Microgrid control for island operation – PQ Control - Droop control methods – Frequency/Voltage Control – Control of Inverter Output Impedance.

Text Books:

1. N. Jenkins, J.B. Ekanayake and G. Strbac, ‘Distributed Generation’, IET Press, 2010.
2. Nikos Hatziargyiou, “Micro grids: Architectures and Control”, Wiley-IEEE Press, December 2013.

Reference Books:

1. Suleiman M. Sharkh, Mohammad A. Abu-Sara, Georgios I. Orfanoudakis, Babar Hussai, “Power Electronic Converters for Microgrid” , Wiley-IEEE Press, 2014.
2. S. Chowdhury, S. P. Chowdury and Peter Crossley,“ Microgrids and Active Distribution Networks” ISBN978-1-84919-014-5, IET renewable Energy series, 2009.

Course Title	**Repair & Rehabilitation of Structures**					**B.Tech CE VII Sem (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE107	**Open Elective (OEC III)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1.5 Hrs						**End Exam Duration: 3 Hrs**		

Course Objectives:
To impart knowledge on the distress in structures.
To Understand the basic concepts of deterioration of structures.
To Understand the serviceability and durability aspect of structures.
Learning the materials used for retrofitting technique.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the cause of deterioration of concrete structures.
CO 2	Able to assess the damage for different type of structures.
CO 3	Summarize the principles of repair and rehabilitation of structures.
CO 4	Recognize ideal material for different repair and retrofitting technique.
CO 5	Know the artificial polymers and rust eliminators used for retrofitting works.

UNIT – I
Introduction
Definition for Repair, Retrofitting, Strengthening and rehabilitation.Physical and Chemical Causes of deterioration of concrete structures.

UNIT – II
Damage Assessment
Purpose of assessment, Rapid assessment, Investigation of damage, Chemical and Physical damages, Evaluation of surface and structural cracks, Damage assessment procedure, destructive, non- destructive, and semi destructive testing systems.

UNIT – III
Influence of Various Elements on Serviceability and Durability
Effects due to climate, temperature, moisture, chemicals, wear and erosion, Design and construction errors, corrosion mechanism, Effects of cover thickness and cracking.

UNIT – IV
Materials for Repair and Retrofitting
Artificial fiber reinforced polymer like CFRP, GFRP,AFRP and natural fiber like Sisal and Jute. Adhesive like, Epoxy Resin, Special concretes andmortars, concrete chemicals, special elements for accelerated strength gain.

UNIT – V
Maintenance and Retrofitting Techniques
Importance of Maintenance. Need for retrofitting, retrofitting of structural members i.e., column and beams by Jacketing technique, externally bonding (ERB) technique.

Text Books:

1. Sidney, M. Johnson, “Deterioration, Maintenance and Repair of Structures”
2. Denison Campbell, Allen & Harold Roper, “Concrete Structures – Materials, Maintenanceand Repair”- Longman Scientific and Technical.
3. Repair and protection of concrete structures by Noel P.Mailvaganam, CRC Press,1991
4. Concrete repair and maintenance Illustrated by Peter.H.Emmons, Galgotia publicationsPvt. Ltd., 2001.

Reference Books:

1. R. T. Allen and S.C. Edwards, “Repair of Concrete Structures”-Blakie and Sons Raiker R.N., “Learning for failure from Deficiencies in Design, Construction and Service”- R&DCenter (SDCPL).
2. M. S. Shetty, Concrete Technology – Theory and Practice, S. Chand & Co. Ltd., NewDelhi.
3. Failures and repair of concrete structures by S.Champion, John Wiley and Sons, 1961
4. Handbook on seismic retrofit of buildings, A. Chakrabarti et.al., Narosa Publishing House,2010.

<table>
<tr><td>Course Title</td><td colspan="4">Geo-Environmental Engineering</td><td colspan="4">B.Tech CE VII Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE108</td><td rowspan="2">Open Elective
(OEC III)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To make the students to learn the concepts of geo-environmental engineering, planning and design of waste in landfills, ash ponds and tailing ponds.
To make the students to understand the effects of pollutants on soil properties
To give awareness about the adverse effects of soil and ground water contaminants
To analyze and apply various techniques for remediation of the contaminants
To make the student to understand the reuse of waste materials in geotechnical constructions.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the different types of contaminants and their effects on subsurface soils</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand the waste contaminants and design the landfill</td></tr>
<tr><td>CO 3</td><td colspan="8">Understand the environmental impacts due to the contaminants of slurry waste</td></tr>
<tr><td>CO 4</td><td colspan="8">Adopt the type of barriers to protect the earth from different contaminants</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand the engineering properties of the waste material and reuse in the construction</td></tr>
</table>

UNIT – I

Introduction

Industrialization and Urbanization, Pollution, Control, and remediation.

Contamination

Surface contamination, Contamination transport, Soil-a Geotechnical trap, Effect of subsurface contamination, Detection of polluted zone

UNIT – II

Contaminants of Solid Waste in Landfills

Waste contaminants, landfills, types, shape, and size of landfills. Liner and liner system, Cover and cover system, Stability of landfills.

UNIT – III

Contaminants of Slurry Wastes

Slurry transported wastes, slurry ponds, operation, Embankment construction and raising, Environmental Impact, and control.

UNIT – IV

Vertical Barriers for Contaminant

Contaminated sites, Types of barriers, Soil-Bentonite slurry trench walls, Cement-Bentonite slurry trench walls and construction material

UNIT – V

Geotechnical Reuse of Waste Materials

Waste reduction, use in geotechnical construction, waste characteristics, transportation consideration, Waste material in Embankment and Fills.

Text Books:

1. Lakshmi N. Reddi and Hilary I. Inyang, “Geoenvironmental Engineering: Principles and Applications”, CRC Press, United States.
2. Hari D. Sharma and Krishna R. Reddy, “Geoenvironmental Engineering: Site Remediation, Waste Containment, and Emerging Waste Management Technologies”, John Wiley and Sons, Inc., United States.
3. G.S. Birdie and J. S. Birdie, Water Supply and Sanitary Engineering, 8th Edition, Dhanpat Rai and Sons Publishers, New Delhi, 2010
4. H.S. Peavy and D.R.Rowe, Environmental Engineering, 1st Edition, McGrawHill Publishing Company, New York, 1984.

Reference Books:

1. David E. Daniel, “Geotechnical Practice for Waste Disposal”, Chapman & Hall, Springer Publishers, Germany.
2. Rowe R. Kerry, “Geotechnical and Geoenvironmental Engineering Handbook”, Springer Publishers, Germany.
3. Proceedings of the International symposium of Environmental Geotechnology (Vol. I and II), Environmental Publishing Company, 1986 and 1989.
4. ASTM Special Technical Publication 874, Hydraulic Barrier in Soil and Rock, 1985.

Course Title	**Environmental Impact Assessment**					**B.Tech CE VII Sem (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE109	**Open Elective (OEC III)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1.5 Hrs						**End Exam Duration: 3 Hrs**		

Course Objectives:
Deals with the various impacts of infrastructure projects on the components of environment and method of assessing the impact and mitigating the same.
The student is able to know about the various impacts of development projects on environment and the mitigating measures.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Perform a critical quality review of an EIA and EIS.
CO 2	Structure the EIA working process considering the need for interdisciplinary.
CO 3	Perform the screening and scoping of an EIA, based on existing Requirements, evaluate the impacts and draw meaningful conclusions from the results of the EIA.
CO 4	Clarify the concept of EIA and its application in an international context to those involved in or affected by the EIA process.
CO 5	Interpretation an EIA, present its conclusions and translate its conclusions into actions.

UNIT – I

Basic Concepts of EIA

Introduction -Initial Environmental Examination – Elements of EIA – Factors Affecting E-I-A – Impact Evaluation and Analysis – Preparation of Environmental Base Map – Classification of Environmental Parameters.

UNIT – II

EIA Methodologies

Introduction – Criteria for the Selection of EIA Methodology – E I A Methods – Ad-Hoc Methods – Matrix Methods – Network Method – Environmental Media Quality Index Method – Overlay Methods and Cost/Benefit Analysis.

UNIT – III

Environmental Management Plan

EMP preparation, Monitoring Environmental Management Plan, Identification of Significant or Unacceptable Impacts Requiring Mitigation, Mitigation Plans and Relief & Rehabilitation, Stipulating the Conditions, Monitoring Methods, Pre- Appraisal and Appraisal.

UNIT – IV

Assessment of Impact on Vegetation and Wildlife

Introduction – Assessment of Impact of Development Activities on Vegetation and Wildlife.

Environmental Audit

Introduction - Environmental Audit & Environmental Legislation – Objectives of Environmental Audit – Types of Environmental Audit – Audit Protocol – Stages of Environmental Audit – Evaluation of Audit Data and Preparation of Audit Report.

UNIT – V

Environmental Acts (Protection and Prevention)

Post Audit Activities-The Air, water, Wild Life and Environmental Protection (Prevention Control Acts).

Case Studies

Preparation of EIA for developmental projects- Factors to be considered in making assessment decisions, Water Resources Project, Pharmaceutical industry, thermal plant, Highway project, Sewage treatment plant,

Text Books:

1. Y Anjaneyulu and Valli Manickam "Environmental Impact Assessment Methodologies", B S Publications, Sultan Bazar, Hyderabad.
2. J Glynn Henry and Gary W Heinke "Environmental Science and Engineering", Prentice-Hall of India (P) Limited, New Delhi.

Reference Books:

1. Dr. Suresh K Dhameja "Environmental Science and Engineering", S K Kataria & Sons Publishers, New Delhi.
2. H S Bhatia "Textbook on Environmental Pollution and Control", Galgotia Publications Pvt. Limited, New Delhi.
3. Rau and Wooten "Environmental Impact Analysis Handbook", Tata McGraw-Hill Companies, Inc. New York.

Course Title	Entrepreneurship					B.Tech ME VII Sem		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20OE311	OEC- III	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		3	0	--	3	30	70	100
Mid Exam Duration: 90 Minutes					End Exam Duration: 3Hrs			

Course Objectives:
Understand the concepts of entrepreneurship, its need and scope Understand meaning of term entrepreneur, classification of entrepreneur and qualities of an entrepreneur.
Concept and procedure of idea generation
Elements of business plan and its procedure
Project management and its techniques
5Behavioral issues and Time management

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Identify opportunities and deciding nature of industry.
CO 2	Know the importance of Women entrepreneurship, Brainstorm ideas for new and innovative products or services.
CO 3	Identify the importance of MSME and know the preparation of Business plan.
CO 4	Use project management techniques like PERT and CPM.
CO 5	Analyze behavioral aspects and use time management matrix.

UNIT-I
Entrepreneur and Entrepreneurship: Concept of Entrepreneur, Characteristics of entrepreneur, Functions of an Entrepreneur, Types of entrepreneur, Concept of Entrepreneurship, Types of Entrepreneurship, Enterprise, Types of Enterprise, Entrepreneurial Myths, Challenges and Opportunities in Entrepreneurship in India, Role of Entrepreneurship in Economic Development,

UNIT-II
Women Entrepreneurship and Choice of Technology: Concept of Women Entrepreneur ,Problems of Women Entrepreneur ,Growth of women entrepreneurship in India, Evaluation of ideas and their sources, Selection of Technology, Collaborative interaction for Technology development, Social Responsibility and Business Ethics.

UNIT-III
MSMEs& New Venture Creation: Concept of MSME, Role & Importance of MSMEs, Growth & development of MSMEs in India, Current schemes for MSMEs, Business opportunities in India, Elements of Business Plan and its salient features presenting a business plan.

UNIT-IV
Project Management: During construction phase, project organization, project planning and control using CPM, PERT techniques, Human aspects of project management, Assessment of tax burden.

UNIT-V
Entrepreneurial Behaviours and Motivation: Introduction, Entrepreneurial Input, And Entrepreneurial Motivation: Concept and Need, Theories of Motivation, Motives for Entrepreneur

Time Management: Approaches of time management, their strengths and weaknesses. Time management matrix and the urgency addiction

Text Books:

1. Elias G. Carayannis,Elpida T. Samara “Innovation and Entrepreneurship”, Springer
2. 2.Vasant Desai, “Dynamics of Entrepreneurial Development and Management”, Himalaya Publishing House, 3. S.S. Khanka, “Entrepreneurial Development”, S. Chand & Co. Pvt. Ltd., New Delhi
3. Prasanna Chandra, “Project-Planning, Analysis, Selection, Implementation and Review”, Tata Mcgraw-Hill Publishing Company Ltd.

Reference Books:

1. Robert D. Hisrich, Michael P. Peters, “Entrepreneurship”, 5/e, Tata Me Graw Hill Publishing Company Ltd., 2015.
2. Stephen R. Covey and A. Roger Merrill, “First Things First”, Simon and Schuster Publication.
3. Sudha G.S., “Organizational Behavior”, National Publishing House, 1996.

<table>
<tr><td>Course Title</td><td colspan="4">Solar Energy Systems</td><td colspan="3">B.Tech ME VII Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE312</td><td rowspan="2">OEC- III</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:
Familiarize with basics of solar radiation, available solar energy and its measurement.
Familiarize with solar collectors, construction and operation of solar collectors.
Understand solar energy conversion systems, applications and power generation.
Learn the principles PV technology and techniques of various solar cells/ materials for energy conversion
Know the advance current technology of the solar energy systems for making the process economical, environmentally safe and sustainable.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Gain Knowledge On Basic Concepts Of Solar Radiation And Solar Collectors.
CO 2	Illustrate Design And Operation Of Solar Heating And Cooling Systems.
CO 3	Discuss The Principles Of Solar Thermo Photovoltaic cells
CO 4	Analyze The Performance Of A Solar Cell Array System.
CO 5	Explain Passive Heating Concepts And Passive Cooling Concepts.

UNIT – I

Solar radiation and collectors

Solar angles – Sun path diagrams – Radiation - extra terrestrial characteristics - measurement and estimation on horizontal and tilted surfaces - flat plate collector thermal analysis - testing methods-evacuated tubular collectors - concentrator collectors – classification - design and performance parameters - tracking systems - compound parabolic concentrators - parabolic trough concentrators - concentrators with point focus - Heliostats – performance of the collectors.

UNIT-II

Solar thermal technologies

Principle of working, types, design and operation of - Solar heating and cooling systems - Thermal Energy storage systems – Solar Desalination – Solar cooker : domestic, community – Solar pond – Solar drying.

UNIT – III

Solar PV fundamentals

Semiconductor – properties - energy levels - basic equations of semiconductor devices physics. Solar cells - p-n junction: homo and hetro junctions - metal-semiconductor interface - dark and illumination characteristics - figure of merits of solar cell - efficiency limits - variation of efficiency with band-gap and temperature - efficiency measurements - high efficiency cells – Solar thermo-photovoltaic cells.

UNIT - IV

SPV system design and applications

Solar cell array system analysis and performance prediction- Shadow analysis: reliability - solar cell array design concepts - PV system design - design process and optimization - detailed array design - storage autonomy - voltage regulation - maximum tracking - centralized and decentralized SPV systems - stand alone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT - V

Solar passive architecture

Thermal comfort - bioclimatic classification – passive heating concepts: direct heat gain - indirect heat gain - isolated gain and sunspaces - passive cooling concepts: evaporative cooling - Radiative cooling - application of wind, water and earth for cooling; shading - paints and cavity walls for cooling - roof radiation traps - earth air-tunnel. – Energy efficient landscape design - thermal comfort.

Text Books:

1. Goswami D.Y., Kreider, J. F. and Francis., “Principles of Solar Engineering’, Taylor and Francis, 2000.
2. 2.Chetan Singh Solanki, “Solar Photovoltatics – Fundamentals, Technologies and Applications”, PHI Learning Private limited,
3. 2011.

Reference Books:

1. Sukhatme S.P.,. Nayak.J.P, ‘Solar Energy – Principle of Thermal Storage and collection”, Tata McGraw Hill, 2008.
2. Solar Energy International, “Photovoltaic – Design and Installation Manual” – New Society Publishers, 2006.
3. Roger Messenger and Jerry Vnetre, “Photovoltaic Systems Engineering”, CRC Press, 2010.

<table>
<tr><td>Course Title</td><td colspan="4">Internal Combustion Engine</td><td colspan="3">B.Tech ME VII Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE313</td><td rowspan="2">OEC- III</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
This course provides techniques of applying management principles to professional positions held by Engineers and Engineering Technologists
The management functions, especially suited to scientist & Professionals in technical and industrial environment are part of the curriculum
Students are exposed to the theory and practices of modern management approaches, tools and techniques in complex industrial & Competitive economic environment</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Use knowledge and comprehension in management tools to apply in technical organizations.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand and build their analytical abilities in the use of Industrial Management</td></tr>
<tr><td>CO 3</td><td colspan="8">Use management techniques to direct the organizations/industries for goal achievement</td></tr>
<tr><td>CO 4</td><td colspan="8">Solve problems associated with the operations management and scheduling of resources in efficiently and effectively.</td></tr>
<tr><td>CO 5</td><td colspan="8">The students may be asked use knowledge of management techniques and write a computer program to address and solve more complicated problems and to study the effect of various parameters on the management/organization</td></tr>
</table>

UNIT – I
Power Cycles:
Carnot cycle, Air standard cycles -Description and representation of Otto cycle, Diesel cycle & Dual cycles on P–V and T-S diagram -Thermal Efficiency – Comparison of Otto, Diesel and Dual cycles. Simple problems on Otto, Diesel and Dual cycles

UNIT-II
I.C. Engines:
Energy conversion – basic engine components –Classification of I.C. Engines, Working principle of two stroke and four stroke engines - comparison of two stoke and four stroke, SI and CI engines –Valve and port timing diagrams, application of I.C Engines.

UNIT – III
Engine Systems:
Working principle of, Magneto & Battery Ignition System - Simple Carburetor - Common rail fuel Injection System - Air & Thermostat cooling system - Petrol & Pressure Lubrication system.

UNIT - IV

Combustion in S.I. Engines:

Homogeneous Mixture - Stages of combustion - Importance of flame speed and factors influencing the flame speed –Abnormal Combustion - Phenomenon of Knocking, Summary of Enginevariables affecting the knocking, pre-ignition.

UNIT - V

Testing and Performance:

Engine Performance Parameters - Determination of brake power, friction power and indicated power – Performance test – Heat balance sheet and chart- Emissions from Diesel & Petrol Engines, Euro Norms - Simple problems on performance and heat balance sheet.

Text Books:

1. I.C. Engines, V. GANESAN- TMH.
2. I.C. Engines / Heywood /McGraw Hill.

Reference Books:

1. Thermal Engineering / R.K Rajput / Lakshmi Publications.
2. I.C Engines – Mathur& Sharma – DhanpathRai& Sons.
3. Engineering fundamentals of I.C Engines – Pulkrabek / Pearson /PHI
4. Thermal Engineering / Rudramoorthy – TMH

<table>
<tr><td>Course Title</td><td colspan="5">Introduction to IOT</td><td colspan="3">Open Electives</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE406</td><td rowspan="2">OE</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>-</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To understand the basics of IOT.
To study the Programming Using Arduino.
To provide the knowledge about sensors and transducers.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand about IoT, its Architecture and its Applications, basic electronics used in IoT & its role.</td></tr>
<tr><td>CO 2</td><td colspan="8">Develop applications with C using Arduino IDE.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze about sensors and actuators.</td></tr>
<tr><td>CO 4</td><td colspan="8">Design IoT in real time applications using today’s internet & wireless technologies.</td></tr>
</table>

Unit I

INTRODUCTION: Introduction to IoT: Evolution of IoT – Definition & Characteristics of IoT - Architecture of IoT – Technologies for IoT – Developing IoT Applications Applications of IoT – Industrial IoT – Security in IoT.

Unit II

BASIC ELECTRONICS FOR IoT: Basic Electronics for IoT: Electric Charge, Resistance, Current and Voltage – Binary Calculations – Logic Chips – Microcontrollers – Multipurpose Computers – Electronic Signals – A/D and D/A Conversion – Pulse Width Modulation.

Unit III

PROGRAMMING USING ARDUINO: Programming Fundamentals with C using Arduino IDE: Installing and Setting up the Arduino IDE – Basic Syntax – Data Types/ Variables/ Constant – Operators – Conditional Statements and Loops – Using Arduino C Library Functions for Serial, delay and other invoking Functions – Strings and Mathematics Library Functions.

Unit IV

SENSORS AND ACTUATORS: Analog and Digital Sensors – Interfacing temperature sensor, ultrasound sensor and infrared (IR) sensor with Arduino – Interfacing LED and Buzzer with Arduino.

Unit V

SENSOR DATA IN INTERNET: Sending Sensor Data Over Internet: Introduction to ESP8266 NODEMCU WiFi Module – Programming NODEMCU using Arduino IDE – Using WiFi and NODEMCU to transmit data from temperature sensor to Open Source IoT cloud platform (ThingSpeak).

Text Books

1. Arshdeep Bahga, Vijay Madisetti, “Internet of Things: A Hands-On Approach”, 2014. ISBN: 978-0996025515.
2. Boris Adryan, Dominik Obermaier, Paul Fremantle, “The Technical Foundations of IoT”, Artech Houser Publishers, 2017.

Reference Books

1. Michael Margolis, “Arduino Cookbook”, O‟Reilly, 2011.
2. Marco Schwartz, “Internet of Things with ESP8266”, Packt Publishing, 2016.
3. Dhivya Bala, “ESP8266: Step by Step Tutorial for ESP8266 IoT, Arduino NODEMCU Dev. Kit”, 2018.

Course Title	**Nano Electronics**					**Open Electives**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE407	**OE**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	-	--	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:
To understand the principles of tunneling, lithography and scaling of physical systems.
To provide the knowledge about MEMS and NEMS.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the divers electronic and device fabrication.
CO 2	Demonstrate the applications of FET and MOSFET
CO 3	Describe lithography.
CO 4	Analyze MEMS and NEMS

Unit-I

Tunnel junction and applications of tunneling, Tunneling Through a Potential Barrier, Metal—Insulator, Metal-Semiconductor, and Metal-Insulator-Metal Junctions, Coulomb Blockade, Tunnel Junctions, Tunnel Junction Excited by a Current Source. Spintronics and Foundations of nano-photonics.

Unit-II

Field Emission, Gate—Oxide Tunneling and Hot Electron Effects in nano MOSFETs, Theory of Scanning Tunneling Microscope, Double Barrier Tunneling and the Resonant Tunneling Diode.

Unit-III

Introduction to lithography- Contact, proximity printing and Projection Printing, Resolution Enhancement techniques, overlay-accuracies, Mask-Error enhancement factor (MEEF), Positive and negative photoresists, Electron Lithography, Projection Printing, Direct writing, Electron resists. Lithography based on Surface Instabilities: Wetting, De-wetting, Adhesion, Limitations, Resolution and Achievable / line widths etc. Lift off process, Bulk Micro machining.

Unit-IV

Introduction to MEMS and NEMS, working principles, as micro sensors (acoustic wave sensor, biomedical and biosensor, chemical sensor, optical sensor, capacitive sensor, pressure sensor and thermal sensor), micro actuation (thermal actuation, piezoelectric actuation and electrostatic actuation–micro gripers, motors, valves, pumps, accelerometers, fluidics and capillary electrophoresis, active and passive micro fluidic devices, Piezoresistivity, Piezoelectricity and thermoelectricity, MEMS/NEMS design, processing, Oxidation, Sputter deposition, Evaporation, Chemical vapor deposition etc.

Unit-V

Introduction – Scaling of physical systems – Geometric scaling & Electrical system scaling. The Single-Electron Transistor: The Single- Electron Transistor Single-Electron Transistor Logic, Other SET and FET Structures, Carbon Nanotube Transistors (FETs and SETs), Semiconductor Nanowire FETs and SETs,Coulomb Blockade in a Nanocapacitor, Molecular SETs and Molecular Electronics.

Text Book:

1. Stephen D. Sentaria, *Microsystem Design, Kluwer Academic Press*
2. Marc Madou, *Fundamentals of microfabrication & Nanofabrication.*
3. T. Fukada & W.Mens, *Micro Mechanical system Principle & Technology, Elsevier, 1998.*
4. Julian W.Gardnes, Vijay K. Varda, *Micro sensors MEMS & Smart Devices, 2001.*

Reference Books:

1. WR Fahrner, “Nano Terchnology and Nano Electronics – Materials, devices and measurement Techniques”, Springer.
2. T.Pradeep, “Nano: The Essentials – Understanding Nano Scinece and Nanotechnology”, Tata Mc.Graw Hill.
3. M. Ziese and M.J. Thornton, “Spin Electronics”
4. Karl Goser, Peter Glosekotter, Jan Dienstuhl, “Nanoelectronics and Nanosystems – From Transistor to Molecular and Quantum Devices”.

<table>
<tr><td>Course Title</td><td colspan="5">Operating Systems
(Open Elective Course -III)</td><td colspan="3">B.Tech VII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE505</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid ExamDuration:90 Minutes</td><td colspan="4">EndExamDuration:3Hrs</td></tr>
</table>

Course Objectives:
Have an overview of functions of operating systems.
Have a thorough knowledge of process management and memory management.
To have a thorough knowledge of how handle to deadlocks.
Learn the concepts of files, protection and security.

Course Outcomes: On successful completion of this course, the students will be able to

CO1	Understand the basic concepts related to the operating systems.
CO2	Analyze the various process scheduling algorithms and process synchronization mechanisms.
CO3	Analyze the various memory management schemes.
CO4	Understand the ways to deal the deadlocks and the basic concepts related to files in the system.
CO5	Analyze the protection and security mechanisms

UNIT - I

Operating Systems Basics: Operating systems functions, Overview of computer operating systems, distributed systems, operating system services and systems calls, system programs, operating system structure.

UNIT - II

Process Management: Process concepts, scheduling-criteria, algorithms, their evaluation.
Concurrency: Process synchronization, the critical-section problem, Peterson‘s Solution, semaphores, monitors.

UNIT-III

Memory Management: Swapping, contiguous memory allocation, paging, structure of the page table, segmentation, virtual memory, demand paging, page-replacement algorithms, Allocation of frames.

UNIT-IV

Deadlocks: system model, deadlock characterization, deadlock prevention, detection and avoidance, recovery form deadlock.
Files: The concept of a file, Access Methods, Directory structure, File system mounting.

UNIT-V

Protection: Protection, Goals of Protection, Domain of protection ,

Access Matrix, Implementation of Access Matrix.
Security: Security problems, User authentication.

Text Books:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, “Operating System Concepts”, Eighth edition, John Wiley.
2. Andrew S Tanenbaum, “Modern Operating Systems”, Fourth Edition, Pearson Education
3. William Stallings, “Operating Systems: Internals and Design Principles”, Sixth Edition2009, Pearson Education.
4. D.M.Dhamdhere, “Operating Systems, A Concept based Approach”, Third Edition, TMH

Reference Books:

1. A.S.Godbole, “Operating Systems”, Second Edition, TMH.
2. Operating Systems: A Spiral Approach – Elmasri, Carrick, Levine, TMH Edition.
3. Operating Systems – H.M. Deitel, P. J. Deitel, D. R. Choffnes, 3rd Edition, Pearson.
4. Operating Systems: A Practical Approach, Rajiv Chopra, 4^{th} Edition, S Chand Publishers.

<table>
<tr><td>Course Title</td><td colspan="4">R Programming
(Open Elective Course - III)</td><td colspan="3">B.Tech VII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE506</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
Optimize business decisions and create competitive advantage with Big data analytics.
Practice java concepts required for developing map reduce programs.
Impart the architectural concepts of Hadoop and introducing map reduce paradigm.
Practice programming tools PIG and HIVE in Hadoop ecosystem.
Implement best practices for Hadoop development.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the installation of VMW is and PIG.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand and apply the setting up and Installing Hadoop in its three operating modes.</td></tr>
<tr><td>CO 3</td><td colspan="8">Implement the file management tasks in Hadoop.</td></tr>
<tr><td>CO 4</td><td colspan="8">Understand Map Reduce Paradigm.</td></tr>
<tr><td>CO 5</td><td colspan="8">Understand Pig Latin scripts sort, group, join, project, and filter your data.</td></tr>
</table>

UNIT-I

Introduction to R: What is R? – Why R? – Advantages of R over Other Programming Languages - R Studio: R command Prompt, R script file, comments – Handling Packages in R: Installing a R Package, Few commands to get started: installed.packages(), packageDescription(), help(), find.package(), library() - Input and Output – Entering Data from keyboard – Printing fewer digits or more digits – Special Values functions : NA, Inf and–inf.

UNIT-II

R Data Types: Vectors, Lists, Matrices, Arrays, Factors, Data Frame – **R - Variables:** Variable assignment, Data types of Variable, Finding Variable ls(), Deleting Variables - **R Operators**: Arithmetic Operators, Relational Operators, Logical Operator, Assignment Operators, Miscellaneous Operators - **R Decision Making:** if statement, if – else statement, if– else if statement, switch statement – **R Loops:** repeat loop, while loop, for loop - Loop control statement: break statement, next statement.

UNIT-III

R-Function : function definition, Built in functions: mean(), paste(), sum(), min(), max(), seq(), user-defined function, calling a function, calling a function without an argument, calling a function with argument values - **R-Strings** – Manipulating Text in Data: substr(), strsplit(), paste(), grep(), toupper(), tolower() - **R Vectors –** Sequence vector, rep function, vector access, vector names, vector math, vector recycling**,** vector element sorting **- R List -** Creating a List, List Tags and Values, Add/Delete Element to or from a List, Size of List, Merging Lists, Converting List to Vector - **R Matrices –** Accessing Elements of a Matrix, Matrix Computations: Addition, subtraction, Multiplication and Division- **R Arrays:** Naming Columns and Rows, Accessing Array Elements, Manipulating Array Elements, Calculation Across Array Elements - **R Factors** –creating factors, generating factor levels gl().

UNIT-IV

Data Frames –Create Data Frame, Data Frame Access, Understanding Data in Data Frames: dim(), nrow(), ncol(), str(), Summary(), names(), head(), tail(), edit() functions - Extract Data from Data Frame, **Expand Data Frame**: Add Column, Add Row - Joining columns and rows in a Data frame rbind() and cbind() – Merging Data frames merge() – Melting and Casting data melt(), cast().

Loading and handling Data in R: Getting and Setting the Working Directory – getwd(), setwd(), dir() - **R-CSV Files -** Input as a CSV file, Reading a CSV File, Analyzing the CSV File: summary(), min(), max(), range(), mean(), median(), apply() - Writing into a CSV File – **R -Excel File** – Reading the Excel file.

UNIT-V

Descriptive Statistics: Data Range, Frequencies, Mode, Mean and Median: Mean Applying Trim Option, Applying NA Option, Median - Mode **- Standard Deviation – Correlation - Spotting Problems in Data with Visualization:** visually Checking Distributions for a single Variable **- R –Pie Charts**: Pie Chart title and Colors – Slice Percentages and Chart Legend, 3D Pie Chart – **R Histograms** – Density Plot **- R – Bar Charts**: Bar Chart Labels, Title and Colors.

Text Books:

1. ROBERT I. KABACOFF "R in Action Data analysis and graphics with R" Manning Publications Co 2011.
2. Seema Acharya, Data Analytics using R, McGrawHill Education (India), 2018, ISBN: 978-93-5260-524-8.
3. Tutorials Point (I) simply easy learning, Online Tutorial Library (2018), *R Programming*, Retrieved from https://www.tutorialspoint.com/r/r_tutorial.pdf.
4. Andrie de Vries, Joris Meys, R for Dummies A Wiley Brand, 2nd Edition, John Wiley and Sons, Inc, 2015, ISBN: 978-1-119-05580-8.

Course Title	**CYBER SECURITY (Open Elective Course – III)**				**B.Tech. VII Sem (R20UG) AI&ML**			
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
20OE3905	**PEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**EndExam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:
To learn about cybercrimes and how they are planned
To learn the vulnerabilities of mobile and wireless devices
The learner will gain knowledge about securing both clean and corrupted systems, protect personal data, and secure computer networks

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understanding the basic cyber security concepts
CO 2	Classifying the international laws and cyber forensics
CO 3	Remembering to cyber-crime.
CO 4	Recognizing cybercrime and cyber terrorism.
CO 5	Understanding the privacy issues.

UNIT - I

Introduction to Cyber Security: Basic Cyber Security Concepts, layers of security, Vulnerability, threat, Harmful acts, Internet Governance – Challenges and Constraints, Computer Criminals, CIA Triad, Assets and Threat, motive of attackers, active attacks, passive attacks, Software attacks, hardware attacks, Spectrum of attacks, Taxonomy of various attacks, IP spoofing, Methods of defense, Security Models, risk management, Cyber Threats-Cyber Warfare, Cyber Crime, Cyber terrorism, Cyber Espionage, etc., Comprehensive Cyber Security Policy.

UNIT - II

Cyberspace and the Law & Cyber Forensics: Introduction, Cyber Security Regulations, Roles of International Law. The INDIAN Cyberspace, National Cyber Security Policy. Introduction, Historical background of Cyber forensics, Digital Forensics Science, The Need for Computer Forensics, Cyber Forensics and Digital evidence, Forensics Analysis of Email, Digital Forensics Lifecycle, Forensics Investigation, Challenges in Computer Forensics, Special Techniques for Forensics Auditing.

UNIT - III

Cybercrime: Mobile and Wireless Devices: Introduction, 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, Mobile Devices: Security Implications for Organizations, Organizational Measures for Handling Mobile, Organizational Security Policies and Measures in Mobile Computing Era, Laptops.

UNIT- IV

Cyber Security: Organizational Implications: Introduction, cost of cybercrimes and IPR issues, web threats for organizations, security and privacy implications, social media

marketing: security risks and perils for organizations, social computing and the associated challenges for organizations.
Cybercrime and Cyber terrorism: Introduction, intellectual property in the cyberspace, the ethical dimension of cybercrimes the psychology, mindset and skills of hackers and other cyber criminals.

UNIT - V
Privacy Issues: Basic Data Privacy Concepts: Fundamental Concepts, Data Privacy Attacks, Data linking and profiling, privacy policies and their specifications, privacy policy languages, privacy in different domains medical, financial, etc.

Text Books:

1. Nina Godbole and Sunit Belpure, Cyber Security Understanding Cyber Crimes, Computer Forensics and Legal Perspectives, Wiley
2. B. B. Gupta, D. P. Agrawal, Haoxiang Wang, Computer and Cyber Security: Principles, Algorithm, Applications, and Perspectives, CRC Press, ISBN 9780815371335, 2018.
3. Cyber Security Essentials, James Graham, Richard Howard and Ryan Otson,CRC Press.
4. Introduction to Cyber Security, Chwan-Hwa(john) Wu,J. David Irwin, CRCPressT&F Group.

Reference Books:

1. Cyber Security Engineering: A Practical Approach for Systems and Software Assurance, Nancy R.Meade, Carol C. Woody, Addison Wesley.
2. The Cyber Security: Self help Guide, Arun Soni, CRC Press.
3. Cyber Security: Analytics, Technology & Automation, Martti Lehto, Pekka Neittaanmaki, Springer.
4. Cyber Security: Essentials, Charles J. Brooks, Christopher Grow, Philip Craig, Donald Short, SYBEX.

Course Title	JAVA PROGRAMMING (Open Elective Course – III)				B.Tech. VII Sem (R20UG) AI&ML		
Course Code	**Category**	**Hours / Week**		**Credits**	**Maximum Marks**		
20OE3906	**OEC**	**L**	**T**	**P**	**C**	**ContinuousInternal Assessment**	**End Exams**	**Total**
		3	0	0	3	40	60	100
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3 Hrs**			

Course Objectives:
To give the students a firm foundation on Java concepts like Primitive data types, Java control flow, Methods, Object-oriented programming, Core Java classes, packages and interfaces, multithreading. To provide the students with an understanding of Java applets, Abstract Window, Toolkit and exception handling.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Solve problems using object oriented approach and implement them using Java
CO 2	Apply the concept of inheritance, polymorphism and Packages, Interfaces
CO 3	Implement Exception handling and able to develop multithreaded applications with synchronization.
CO 4	Able to develop applets for web applications.
CO 5	Able to design GUI based applications.

UNIT – I
Object Oriented Programming basics: Need for OOP paradigm, Principles of OOP concepts.
Java Basics: History of Java, Java buzzwords, Simple java program, classes and objects – concepts of classes, objects, constructors, methods, Introducing access control**, this** keyword, overloading methods and constructors.

UNIT – II
Inheritance: Inheritance basics, Types of Inheritance, benefits of inheritance, **super** uses, using **final** with inheritance, polymorphism- method overriding, abstract classes.
Packagesand Interfaces: Defining, Creating and Accessing a Package, importing packages, differences between classes and interfaces, defining an interface, implementing interface, applying interfaces, variables in interface and extending interfaces.

UNIT – III
Exception handling and multithreading: Concepts of exception handling, exception hierarchy, usage of try, catch, throw, throws and finally, creating own exception sub classes. Differences between multi threading and multitasking, thread life cycle, creating threads, synchronizing threads.

UNIT – IV
Event Handling: Events, Event sources, Event classes, Event Listeners, Delegation event model, handling Mouse and Keyboard events, Adapter classes, The AWT class hierarchy, user interface components- Labels, Button, Scrollbars, Text Components, Check box, Choices,
UNIT – V

Applets: Concepts of Applets, differences between applets and applications, life cycle of an Applet, creating applets, passing parameters to applets.

Text Books:

1. Java; the complete reference, 7th editon, Herbert schildt, TMH.
2. Understanding OOP with Java, updated edition, T. Budd, Pearson Education.
3. Core Java 2, Vol 1, Fundamentals, Cay.S.Horstmann and Gary Cornell,eighth Edition, Pearson Education.
4. Core Java 2, Vol 2, Advanced Features, Cay.S.Horstmann and Gary Cornell,eighth Edition, Pearson Education.

Reference Books:

1. An Introduction to programming and OO design using Java, J.Nino andF.A.Hosch, John wiley & sons.
2. An introduction to Java programming and object oriented applicationdevelopment, R.A. Johnson- Thomson.
3. Object Oriented Programming through Java, P. Radha Krishna, University Press.

Course Title	Transforms and Their Applications					OPEN ELECTIVE-III		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE612	**BSC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3		--	3	40	60	100
Mid Exam Duration: 90 min						**End Exam Duration: 3Hrs**		

Course Objectives:
To enable the students to apply the knowledge of mathematics in various engineering fields by making them to learn the following:
Laplace Transforms is used for making predictions and making analysis in data mining.
Laplace transforms in engineering problems.
Understand Fourier Transforms and apply them in solving problems.
Inculcate the concept of Z-Transforms and its applications.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	**Understand** Laplace Transforms in engineering problems.
CO 2	**Apply** Laplace Transforms in engineering problems.
CO 3	**Understand** Fourier Transforms in engineering problems.
CO 4	**Apply** Fourier Transforms in engineering problems.
CO 5	**Understand** concept of Z-Transforms and its applications.

UNIT I:
Laplace transforms of standard functions – Properties of Laplace Transforms - Transforms of derivatives and integrals- Evaluation of integrals by Laplace transforms – Unit step function – Second shifting theorem – Dirac’s delta function. Laplace transforms of periodic functions.

UNIT II:
Inverse Laplace Transforms. Convolution theorem – Applications of Laplace transforms to ordinary differential equations.

UNIT III:
Fourier integral theorem (only statement) – Fourier sine and cosine integrals. Fourier transform – Fourier sine and cosine transforms – Properties of Fourier transform.

UNIT: IV:
Inverse transforms – Convolution theorem of Fourier transform- Parseval’s identity for Fourier transforms- Relation between Fourier and Laplace transforms. Fourier transforms of the derivatives of a Function. Applications of transforms of boundary value problems (Only Heat Conduction).

UNIT V
z-transform – Inverse z-transform – Properties – Damping rule – Shifting rule – Initial and final value theorems. Convolution theorem – Solution of difference equations by z-transforms.

Text Books:

1. Higher Engineering Mathematics, Dr. B.S. Grewal, Khanna Publishers-43 edition 2014.
2. Advanced Engineering Mathematics, Erwin Kreyszig, Wiley Publications, 9^{th} edition-2013.
3. Engineering Mathematics Volume-1, Dr. D.S Chandra Sekharaiah, Prism Books Pvt. Ltd.
4. Engineering Mathematics by Srimanta Pal, Subodh C. Bhunia, Oxford University Press.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, Mc. Graw Hill Education (India) Pvt. Ltd, New Delhi, 11^{th} Edition, Reprint 2010.
2. A Text Book of Engineering Mathematics, N.P. Bali and Manish Goyal, Lakshmi Publications, Reprint 2008.
3. Advanced Engineering Mathematics, Greenberg Michael D, Cengage Publishers.
4. Introduction to Laplace Transforms and Fourier Series, Philip Dyke, Springer.

Course Title	**PHYSICS OF RENEWABLE ENERGY**					**OPEN ELECTIVE – 3**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE613	**BSC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End lab Exams**	**Total**
		3	**0**	**0**	**3**	40	60	100
					End Exam Duration: 3Hrs			

COURSE OBJECTIVES:
1. A top priority for developing renewable energy in India is to boost the economy, encourage the development of energy security, and reduce carbon emissions.
2. Promote sustainable development and promote economic integration.
3. Ensure that any energy sector products that come into use do so with minimal impact on the environment.
4. Take every step to ensure that energy generation, conversion, and use are cost-competitive.

COURSE OUTCOMES: Upon completion of the course, the student will be able to:

CO1	**Understand** the energy resources.
CO2	**Apply** the Solar energy.
CO3	**Idealized** wind turbine
CO4	**Underground** heat – Micro hydro plants.
CO5	**Classify** the different types of energy resources.

UNIT I: Bio diversity conception individuals

Introduction to renewable energy– Biogas cogeneration – Wood as a source of energy – Energy crops – Bio diesel – Fuel from plantation – Ethanol – Synthesis fuels.

UNIT II: Solar energy

Solar thermal: Solar collectors – Hot water from Sun – Cooling with the Sun – Solar drying – Air collectors – Solar thermal power plants.

Solar electric: Photo voltaic effect – The heart of a PV array – The solar cell – Solar energy as part of sustainable development.

UNIT III: Wind Energy

Power in the wind: Aerodynamics principles of wind turbines – Power available in the wind – Rotor efficiency – Factors affecting wind power – Impact of tower height – Wind turbines sitting – Idealized wind turbine – Power curve – Speed control for maximum power.

UNIT IV: Hydro-Energy

Introduction -Water power – Ocean wave and tidal energies – Hydro power nature conservation – Underground heat – Micro hydro plants.

UNIT V: Geothermal Energy

Introduction-Geothermal Resource -Mining Thermal Energy From a Hot Dry Rock-Geothermal Heat Pumps-Active Volcanoes, Plate Tectonics, and the “Ring of Fire”.

Text books:

1. Hand book of renewable energy technology -A.F.Zobba and R.Bansal, World scientific publications.
2. Renewable energy: The facts - Dieter Scirfried and Walter Witzel. Earth scan publications for sustainable future.

Reference books:

1. http://www.law.du.edu/index.php/the-renewable-energy-reader/6-geothermal

<table>
<tr><td>Course Title</td><td colspan="5">Fuel Technology</td><td colspan="3">B. Tech.
(Open elective-III)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE614</td><td rowspan="2">Open Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
The students will have the general knowledge of Fuels in the context of clean power, sustainability and alternative fuels
To build up knowledge of concepts and theories of fuel combustion & control process</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Recall the Characteristics & properties of a fuel.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the concepts of solid fuels and evaluate the calorific value of solid fuels by Bomb Calorimeter.</td></tr>
<tr><td>CO 3</td><td colspan="8">Explore the synthesis of synthetic petrol & process of Refining of petroleum.</td></tr>
<tr><td>CO 4</td><td colspan="8">Identify various gaseous fuels and explain their preparation and properties.</td></tr>
<tr><td>CO 5</td><td colspan="8">Discuss about the purpose of different alternative fuels, merits & demerits of alternative fuels</td></tr>
</table>

UNIT-I-Introduction

Fuels-Introduction, Classification of Fuels, Differences between Solid, Liquid & gaseous fuels. Characteristics of a Good fuel, Calorific Value of Fuels-Gross calorific value(GCV) & Net calorific Value (NCV)- definition, units & their relation, Numerical problems on calorific value.

UNIT-2-Solid Fuels

Introduction, Types of Coal, Coal formation, Properties, Advantage & disadvantages of solid fuels. Proximate & Ultimate analysis of coal. Manufacture of metallurgical Coke-Otto Hoffmann method, Determination of Calorific value of solid fuel by Bomb calorimeter,

UNIT-3-Liquid Fuels

Introduction, Properties, Advantages & disadvantages of Liquid fuels, Classification of petroleum, refining of petroleum-Fractional distillation of crude oil, uses of various petroleum products, Synthetic Petrol- methods-Fischer-Tropsch method and Bergius process. Knocking-Octane number, Cetane Number-Definitions

UNIT-4-Gaseous Fuels

Introduction, Properties, Advantages & disadvantages Of Gaseous fuels - Preparation, properties & uses of Natural gas, producer gas, water gas, Propane. Determination of calorific value of gaseous fuels by Junker's Gas Calorimeter-Principle & applications.

Unit-5-Need for Alternate Fuels

Need for alternate fuels- Effects of Exhaust gas emissions on environment & Humans (NO, NO_2, CO_2, CO, SO_X). Introduction to alternate fuels- General uses of alternate fuels like Hydrogen, LPG, CNG, Biogas, Methanol, Ethanol, Butanol. Biofuels-Types of Biofuels, Applications of Biofuels, Merits & demerits of alternate fuels.

Textbooks:

1. Text Book of Engineering Chemistry, Shashi Chawla, Dhanapath Rai Publications, New Delhi, 4th Edition, 2011.
2. Internal Combustion Engine Fundamentals, Heywood John B, Pragnya IAS Publications
3. General Chemistry for Engineers, Jeffrey S. Gaffrey & Nancy A. Marky
4. Fuels & Fuel- Additives, S.P.Srivastava , Jeno Hancsok, Willey Publications

REFERENCES:

1. A Text Book of Engineering Chemistry, Jain and Jain, Dhanapath Rai Publishing Company, New Delhi, 15th Edition, 2010.
2. Alternative Liquid fuels, Desai Ashok V, Willey Publications
3. Introduction to Combustion, Turns Stephen R, Mc GrawHill Publications
4. Fuels and Fuels Technology, Wilfrid Francis, Martin C. Peters, 2nd edition, Elsevier publications

Course Title	**PROFESSIONAL COMMUNICATION**					**OPEN ELECTIVE – III**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE615	**HUM**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**--**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hours**			

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	The students will be able to understand the processes of communication and apply communication techniques for effective communication.
CO 2	The students will be able to improve group behaviour and participate effectively in the team work thereby improving professional prospects.
CO 3	The students will be able to present effectively orally and in writing

Unit :1

Professional Communication

Role of Professional Communication- Professional Communication Skills- Tips to improve professional communication skills.

Unit 2

Technical Communication

Significance of technical communication- Use of vocabulary in formal letters / reports and e-mails.- Compound words , misspelled words, using of similar words to express the idea, analogies. Grammar: Subject - Verb agreement, Active and Passive voice, Embedded sentences, clauses and conditionals.

Unit 3

Reading Comprehension

Comprehension - Reading comprehension Techniques-Styles, speed and evaluation of Reading - critical reading- Paraphrasing / summarizing: SQ3R method, PQRST method

Unit 4

Oral Presentation

Oral Presentation techniques- Public speaking - guidelines for presentation- tone and voice modulation- Use of visuals in presentation- Group Discussion - strategies

Unit 5

Writing Skills

Writing - formal and informal writing - formal and informal letters - formal and informal reports- Common errors in writing, elements of styles- Analytical and issued based essays.

Reference Books

1. Ashraf Rizvi, "Effective Technical Communication", 2nd Edition, McGraw Hill Education, 2017.
   2. Raman Sharma, “Technical Communications”, Oxford Publication, London, 2004.
2. Meenakshi Raman and Sangeetha Sharma, “Technical Communication: Principles
3. Practice”, 2nd Edition, Oxford University Press, 2011
4. English for Engineers and Technologists (Combined edition, Vol. 1 and 2), Orient Black swan 2010.
5. Stephen E. Lucas, "The Art of Public Speaking", 10th Edition; McGraw Hill Education, 2012.
6. William Strunk Jr. & E.B. White, "The Elements of Style", 4th Edition, Pearson, 1999.
7. David F. Beer and David McMurrey, Guide to writing as an Engineer, John Willey. New York, 2004.
8. Goodheart-Willcox, "Professional Communication", First Edition, 2017.
9. Training in Interpersonal Skills: Tips for Managing People at Work, Pearson Education, India, 6 editions,2015.
10. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1edition, 2013.

<table>
<tr><td>Course Title</td><td colspan="5">Digital & Social Media Management</td><td colspan="3">B. Tech.
Open Elective - III</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE616</td><td rowspan="2">Open Elective (OEC)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Min</td><td colspan="3">End Exam Duration : 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the course is
Review key trends within the Digital Marketing landscape. Examine an example of each Digital Marketing channel.
Examine SEO’s Position as a Fundamental Building Block for Online Marketing
Identify and appropriately apply Fundamental Factors That Result in Achieving Top Search Engine Rankings.
Develop an email and sending strategy that adheres to email compliance best practices. Analyze the role that social marketing plays in the digital landscape and marketing mix.
Identify and incorporate individual social and mobile platforms into a digital marketing strategy.
Utilize Google Analytics to examine the role that web analytics play in digital marketing</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Explain the role and importance of digital marketing, Ability to comprehend how digital media can be used for current marketing practices.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understanding of Search Engine optimization, Pay per click and Email marketing,</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the role that social media marketing plays in the digital landscape and marketing mix.</td></tr>
<tr><td>CO 4</td><td colspan="8">Identify and incorporate individual social and mobile media platforms into a digital marketing strategy.</td></tr>
<tr><td>CO 5</td><td colspan="8">Understanding of content creation, content marketing channels, writing messages and content marketing plan, Utilize Google Analytics to examine the role that web analytics play in digital marketing.</td></tr>
</table>

Unit I

Introduction to Digital Marketing: Introduction to marketing in the digital environment, Online marketplace analysis: micro-environment - The Internet macro-environment, What Are the 3i Principles?

Unit II

Digital Marketing Strategy: Content Marketing - Online Offer - Online Space / website Selling - Online Value - Internet for Distribution.

Search Engine Marketing: Search Engine Optimization, Pay Per Click, Digital Display Advertising, Introduction to page rankings, Email Marketing.

Unit III

Social Media Marketing: Social Media, Social Media Mining, Content guidelines for online communications, Social Media Channels and Social Media Strategy. Cybercrime and security.

Unit IV

Mobile Marketing: Mobile Marketing Fundamentals, Mobile consumers, Digital consumption, M-commerce, Technological change and marketing, Overview of mobile and app based marketing, Mobile websites, Conducting Mobile Audits, Strategic objectives.

Unit V

Facebook for Business: Facebook for Business-Facebook fan Engagement, Anatomy of Ad Campaign, Adverts Types of adverts, Adverts Targeting. Case Study-Tata DoCoMo

Text Books

1. Digital Marketing: by Raghavendra K & ShrutiPrabhakar, HPH

References

1. e Marketing: The Essential Guide to Digital Marketing: by Rob Stokes (2010), Quirk Education.
2. The Art of Digital Marketing: by Ian Dodson, Wiley.
3. Social Media Marketing: Strategies for Engaging in Facebook, Twitter & Other Social Media: by Liana Evans, Que Publishing
4. E-Marketing: by Strauss, J. and Frost, R., Pearson Education, Inc

Course Title	Industrial Safety Engineering					B.Tech CE VII Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE110	**Open Elective (OEC-IV)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1.5 Hrs						**End Exam Duration: 3 Hrs**		

Course Objectives:
The course is intended to give knowledge of various safety management principles, various safety systems, various machine guarding devices, hazard identification techniques, energy sources, systems & applications and the need in the present context. Learners will be able to compare different hazard identification tools and choose the most appropriate based on the nature of industry

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Describe the theories of accident causation and preventive measures of industrial accidents
CO 2	Explain about personal protective equipment, its selection, safety performance & indicators and importance of housekeeping
CO 3	Explain different safety issues in construction industries.
CO 4	Describe various hazards associated with different machines and mechanical material handling.
CO 5	Utilise different hazard identification tools in different industries with the knowledge of different types of chemical hazards.

UNIT – I
Safety Introduction
Need for safety. Safety and productivity. Definitions: Accident, Injury, Unsafe act, Unsafe Condition, Dangerous Occurrence, Reportable accidents. Theories of accident causation. Safety organization- objectives, types, functions, Role of management, supervisors, workmen, unions, government and voluntary agencies in safety. Safety policy. Safety Officer-responsibilities, authority. Safety committee-need, types, advantages.

UNIT – II
Personal Protection in Work Environment
Personal protection in the work environment, Types of PPEs, Personal protective equipment respiratory and non-respiratory equipment. Standards related to PPEs. Monitoring Safety Performance: Frequency rate, severity rate, incidence rate, activity rate. Housekeeping: Responsibility of management and employees. Advantages of good housekeeping. Work permit system- objectives, hot work and cold work permits. Typical industrial models and methodology. Entry into confined spaces.

UNIT – III
Safety Issues in Construction
Introduction to construction industry and safety issues in construction Safety in various construction operations – Excavation and filling – Under-water works – Under-pinning & Shoring – Ladders & Scaffolds – Tunneling – Blasting – Demolition – Confined space – Temporary Structures. Familiarization with relevant Indian Standards and the National Building Code provisions on construction safety. Relevance of ergonomics in construction safety. Ergonomics Hazards - Musculoskeletal Disorders and Cumulative Trauma Disorders.

UNIT – IV

Safety Hazards in Machines

Machinery safeguard-Point-of-Operation, Principle of machine guarding -types of guards and devices. Safety in turning, and grinding. Welding and Cutting-Safety Precautions of Gas welding and Arc Welding. Material Handling-Classification-safety consideration- manual and mechanical handling. Handling assessments and techniques- lifting, carrying, pulling, pushing, palletizing and stocking. Material Handling equipment-operation & maintenance. Maintenance of common elements-wire rope, chains slings, hooks, clamps. Hearing Conservation Program in Production industries.

UNIT – V

Hazard and Risk

Types of hazards –Classification of Fire, Types of Fire extinguishers, fire explosion and toxic gas release, Structure of hazard identification and risk assessment.

Text Books:

1. R.K Jain (2000) Industrial Safety, Health and Environment management systems, Khanna Publications.
2. Paul S V (2000), Safety management System and Documentation training Programme handbook, CBS Publication.
3. Krishnan, N.V. (1997). Safety management in Industry. Jaico Publishing House, New Delhi.
4. John V. Grimaldi and Rollin H.Simonds. (1989) Safety management. All IndiaTraveller Book Seller, Delhi.

Reference Books:

1. Ronald P. Blake. (1973). Industrial safety. Prentice Hall, NewDelhi.
2. Alan Waring. (1996). Safety management system. Chapman & Hall, England.
3. Vaid, K.N., (1988). Construction safety management. National Institute of Construction Management and Research, Mumbai.
4. AIChE/CCPS. (1992). Guidelines for Hazard Evaluation Procedures. (second edition). Centre for Chemical Process Safety, American Institute of Chemical Engineers, New York.

<table>
<tr><td>Course Title</td><td colspan="5">Surveying</td><td colspan="3">B.Tech CE VII Sem (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE111</td><td rowspan="2">Open Elective
(OEC IV)</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td></td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration: 1.5 Hrs</td><td colspan="3">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
Be familiar with Chain and Compass in measuring the horizontal and verticaldistances, calculating simple areas, and correcting different errors.
Identify the level instruments; record the levels in field book and determine thereduced levels of objects by different methods.
Determine the areas and volumes on the field by different rules and methods.
Using totalstation instrument for measuring the distances, angles, and areas.
Understand the concepts of photogrammetry and remote sensing which can be used in higher surveying.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
</table>

CO 1	Compute linear and areal measurements by using chain and compass.
CO 2	Gain the knowledge on levelling and contouring techniques and its applications.
CO 3	Apply the modern surveying techniques for various field problems
CO 4	Know the uses of total station instrument for different field applications
CO 5	Know the concepts of Phostogrammetry and Remote sensing

UNIT-I

Introduction to Surveying: Definition; Classification; Principles of surveying; Errors in surveying: Types of errors; Ranging, Principles of chain surveying; Basic definitions.
Compass Surveying: Prismatic compass, Surveyor's compass, Whole Circle and Quadrant Bearing, Included angles, and errors.

UNIT – II

Levelling: Different methods of levelling, Different types of level instruments, Levelling staff, Level field book, Reciprocal Levelling, Evaluation of Reduced Levels byRise and Fall Method, and Height of Instrument Method
Areas: Introduction; Simpson's rule; Boundaries with offsets at irregular intervals; coordinate method; level section; two level section; trapezoidal and prismoid rule.

UNIT – III

Modern Field Survey Systems: Principle of Electronic Distance measurement; types of EDM instruments, total station, parts, accessories – advantages and applications, field procedure for total station survey, Errors in Total Station Survey; Global Positioning Systems- Segments.

UNIT – IV

PHOTOGRAMMETRIC SURVEYING: Introduction, Basic concepts, perspective geometry of aerial photograph, relief, and tilt displacements, and terrestrial photogrammetric

UNIT – V

REMOTE SENSING: Definition, Energy Principles, radiation principles, principles, and Use of EMR spectrum, Energy interactions in atmosphere- Scattering, Absorption, Energy interactions with h surface features and concepts of spectral reflectance curve.

Text Books:

1. B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain, Surveying – Vol. I, II and III, Laxmi Publications (P) Ltd., 17th Edition, 2016.
2. R. Subramanian, Surveying and Levelling, Oxford University Press, 2nd Edition, 2012.
3. Chandra, A.M, Plane Surveying, 2nd Edition, New Age International Publishers, NewDelhi, 2010.
4. Surveying (Vol – 1, 2 & 3), by B. C. Punmia, Ashok Kumar Jain and Arun Kumar Jain -Laxmi Publications (P) ltd., New Delhi.

Reference Books:

1. S. K. Duggal, Surveying – Vol. I and II, Tata McGraw–Hill Publishing Co. Ltd., 4th Edition,2013.
2. Arthur R. Benton and Philip J. Taetz, Elements of Plane Surveying, McGraw-Hill, 3rdEdition,2010.
3. Arora, K. R., Surveying – Vol. I and II, Standard Book House, 14th Edition, 2011.
4. T. P. Kanetkar and S. V. Kulkarrni, Surveying and Levelling, Pune Vidyarthi GrihaPrakashan, Pune, 24th Edition, 2013.

Course Title	**Traffic Engineering**					**B.Tech CE VII Sem (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE112	**Open Elective (OEC IV)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1.5 Hrs						**End Exam Duration: 3 Hrs**		

Course Objectives:
The objective of this course is to impart knowledge about various components and characteristics of traffic to understand concepts like Highway capacity and level of service concepts. To know various traffic control devices and principles of highway safety.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Conduct different engineering surveys required for highway planning and design
CO 2	Analyze the traffic flow patterns and delay patterns
CO 3	Understand the role and importance of various traffic control devices
CO 4	Know the impact of traffic on environmental pollution and standard pollution limits
CO 5	Understand the concepts of level of service of highways along with various highway systems required for traffic surveillance

UNIT – I
Components of the Traffic System
Human-Vehicle–Environment System; characteristics of Road users, Vehicles, Highways and their classification; Traffic Studies: Inventories; Volume studies; Speed, Accident studies.

UNIT – II
Traffic Characteristics
Microscopic and macroscopic flow characteristics: Time headways; Temporal, spatial and model flow patterns; Interrupted and Un interrupted traffic. Travel time and delay studies, Car-following theories.

UNIT – III
Traffic Control Devices & Highway Safety
Traffic signs & Markings; Signal Warrants; Signal phasing and Development of phase plans; Fixed and Vehicle activated signals; Accident characteristics – Road – Driver – Vehicle; Accident recording and Analysis; Highway Safety Improvement Program; Safety Audit.

UNIT – IV
Environmental Considerations
Air pollution: Kinds of pollutants; Air pollution standards; Measures of air quality; modelling and control. Noise pollution: Measurement of sound levels; Acceptable limits, Prediction of noise levels, Traffic noise control.

UNIT – V
Highway Capacity and Level of Service
Capacity and level of service; Factors affecting Capacity and LOS; Capacity of Rural

Highways, Capacity of Urban Roads;
Highway Systems: Traffic surveillance and monitoring; Intelligent vehicle highway system. IVHS programs, Role of IVHS, IVHS categories, Benefits and Costs of IVHS.

Text Books:

1. L R Kadiyali "Principles and Practice of Highway Engineering", Khanna Publishers, NewDelhi.
2. S K Khanna, C E G Justo and A Veeraragavan "Highway Engineering", Nemchand Publications, New Delhi.
3. Papacoastas, C. S. and Prevedouros, Transportation Engineering and Planning, ThirdEdition, Third Impression; Pearson Education, 2018.
4. Highway Engineering, Paul H. Wright and Karen K Dixon, Wiley Student Edition, WileyIndia (P) Ltd., New Delhi

Reference Books:

1. G V Rao "Principles of Transportation and Highway Engineering", Tata McGraw-HillCompanies, Inc. NewYork.
2. Partha Chakroborthy, Animesh Das, "Principles of Transportation Engineering", PrenticeHall of India, New Delhi.
3. S P Bindra "Highway Engineering", Dhanpath Rai & Sons, New Delhi.
4. Traffic & Highway Engineering by Nicholas J. Garber, Lester A. Hoel, Fifth Edition, published in 2015, CENGAGE Learning, New Delhi.

Course Title	**Energy Auditing**					**B.Tech ME VII Sem**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE314	**OEC- IV**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:
Introduce the concepts of energy scenario and need for energy policy for industries in India.
Familiarize with the Energy Audit concepts and its approaches.
Teach the principles and objectives of the Energy management.
Discuss the Thermal and Electrical Energy management.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Explain the fundamental aspects of energy scenario in India.
CO 2	List the various national and state level energy policy.
CO 3	Explain the concepts of energy conservation in boilers.
CO 4	Identify the thermal energy components.
CO 5	Explain the concepts of supply side methods to minimize supply.

UNIT–I

General Aspects
Review of energy scenario in India, General Philosophy and need of Energy Audit and Management, Basic elements and measurements - Mass and energy balances – Scope of energy auditing industries - Evaluation of energy conserving opportUNITies, Energy performance contracts, Fuel and Energy substitution, Need for Energy Policy for Industries, National & State level energy Policies.

UNIT-II

Energy Audit Concepts
Need of Energy audit - Types of energy audit – Energy management (audit) approach - understanding energy costs - Bench marking – Energy performance - Matching energy use to requirement - Maximizing system efficiencies -Optimizing the input energy requirements - Duties and responsibilities of energy auditors- Energy audit instruments - Procedures and Techniques.

UNIT – III

Principles and Objectives of Energy Management
Design of Energy Management Programmes - Development of energy management systems – Importance - Indian need of Energy Management - Duties of Energy Manager - Preparation and presentation of energy audit reports - Monitoring and targeting, some case study and potential energy savings.

UNIT – IV

Thermal Energy Management

Energy conservation in boilers - steam turbines and industrial heating systems - Application of FBC - Cogeneration and waste heat recovery -Thermal insulation - Heat exchangers and heat pumps –HVC industries-Building Energy Management.

UNIT-V

Electrical Energy Management

Supply side Methods to minimize supply-demand gap- Renovation and modernization of power plants - Reactive power management – HVDC- FACTS - Demand side - Conservation in motors - Pumps and fan systems – Energy efficient motors.

Text Books:

1. Murphy, W. R., Energy Management, Elsevier, 2007.
2. Smith, C. B., Energy Management Principles, Pergamum, 2007
3. Handbook of Energy Audit, Sonal Desai, Mcgraw Hill Education Private Ltd

Reference Books:

1. Turner, W. C., Doty, S. and Truner, W. C., Energy Management Hand book, 7th edition, Fairmont Press, 2009.
2. De, B. K., Energy Management audit & Conservation, 2nd Edition, Vrinda Publication, 2010.
3. Energy Management Handbook – W.C. Turner (John Wiley and Sons, A Wiley a. Interscience publication)
4. Industrial Energy Management and Utilisation –L.C. Witte, P.S. Schmidt, D.R. Brown (Hemisphere Publication, Washington, 1988)
5. Industrial Energy Conservation Manuals, MIT Press, Mass, 1982
6. Energy Conservation guide book Patrick/Patrick/Fardo (Prentice hall1993)

<table>
<tr><td>Course Title</td><td colspan="5">Sustainable Engineering</td><td colspan="3">B.Tech ME VII Sem</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE315</td><td rowspan="2">OEC- IV</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To have an increased awareness among students on Issues in areas of sustainability.
To understand the role of Engineering and technology within sustainable development
To know the Methods ,tools and incentives for sustainable product service system development
To Establish a clear understanding of the role and impact of various aspects of Engineering and emerging decisions on environmental, societal and economic problems</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the relevance and the concept of sustainability and the global initiatives in this Direction.</td></tr>
<tr><td>CO 2</td><td colspan="8">Explain the different types of environmental pollution problems and their sustainable</td></tr>
<tr><td>CO 3</td><td colspan="8">Discuss the environmental regulations and standards .</td></tr>
<tr><td>CO 4</td><td colspan="8">Outline the concepts related to conventional and non-conventional energy</td></tr>
<tr><td>CO 5</td><td colspan="8">Demonstrate the broad perspective of sustainable practices by utilizing engineering knowledge and principles.</td></tr>
</table>

UNIT-I

Sustainability:
Introduction, concept, evolution of the concept; Social, environmental and economic sustainability concepts; Sustainable development, Nexus between Technology and Sustainable development; Millennium Development Goals (MDGs) and Sustainable Development Goals (SDGs), Clean Development Mechanism (CDM).

UNIT – II

Environmental Pollution:
Air Pollution and its effects, Water pollution and its sources, Zero waste concept and 3 R concepts in solid waste management; Greenhouse effect, Global warming, Climate change, Ozone layer depletion, Carbon credits, carbon trading and carbon foot print, legal provisions for environmental protection.

UNIT – III

Environmental management standards: ISO 14001:2015 frame work and benefits, Scope and goal of Life Cycle Analysis (LCA), Circular economy, Bio-mimicking, Environment Impact Assessment (EIA), Industrial ecology and industrial symbiosis.

UNIT – IV

Resources and its utilization: Basic concepts of Conventional and non-conventional energy, General idea about solar energy, Fuel cells, Wind energy, Small hydro plants, bio-fuels,

Energy
derived from oceans and Geothermal energy.

UNIT-V

Sustainability practices: Basic concept of sustainable habitat, Methods for increasing energy
efficiency in buildings, Green Engineering, Sustainable Urbanization, Sustainable cities, Sustainable transport

Text Books:

1. Sustainable Engineering: Drivers, Metrics, Tools, And Applications
2. Krishna R. Reddy, Claudio Cameselle, Jeffrey A. Adams.
3. Introduction to Sustainability for Engineers ByTulseeram, Ramjeawon
4. sustainable Engineering: Principles and Practice Hardcover – 13 June 2019 by Bhavik R.
5. Bakshi

Reference Books:

1. Allen, D. T. and Shonnard, D. R., Sustainabilitngineering: Concepts, Design and Case Studies,PrenticeHall.

2. Bradley. A.S; Adebayo,A.O., Maria, P. Engineering applications in sustainable design and development, Cengage leaming

3. Environment Impact Assessment Guidelines, Notification of Government of India, 2006

4. 4.Mackenthun, K. M., Basic Concepts in Environmental Management, Lewis Publication,, London, 1998

5. ECBC Code 2007, Bureau of Energy Efficiency, New Delhi Bureau of Energy Efficiency Publications-Rating System, TERI Publications - GRIHA Rating System

Course Title	Industrial Engineering & Management					B.Tech ME VII Sem		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE316	**OEC- IV**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:
This course provides techniques of applying management principles to professional positions held by Engineers and Engineering Technologists
The management functions, especially suited to scientist & Professionals in technical and industrial environment are part of the curriculum
Students are exposed to the theory and practices of modern management approaches, tools and techniques in complex industrial & Competitive economic environment

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the concepts of Management, organization principles and also motivational qualities and leadership.
CO 2	Apply the knowledge where to and how to locate a plant, difficulties of plant layout.
CO 3	Evaluate various types of work studies processing charts and job evaluation techniques.
CO 4	Apply types of control charts and improvement of quality with analysis techniques.
CO 5	Use knowledge of management techniques in improving the Entreprise planning and project management.

UNIT-I

INTRODUCTION:
Concepts of Management and Organization – Functions of Management – Evolution of Management Thought : Taylor‟s Scientific Management, Fayol‟s Principles of Management, Douglas McGregor‟s Theory X and Theory Y, Mayo‟s Hawthorne Experiments, Hertzberg‟s Two Factor Theory of Motivation, Maslow‟s Hierarchy of Human Needs, Systems Approach to Management.

UNIT-II

PLANT LOCATION & LAYOUT:
Plant location, definition, factors affecting the plant location, comparison of rural and urban sites- methods for selection of plant.Types of production systems, Plant Layout – definition, objectives and types of plant layout.

UNIT-III

WORK STUDY:
Introduction, objectives of work study, steps in work study, purpose of method study, procedure of method study, recording techniques. Work measurement-purpose of work measurement, time studyprocedure-performance rating, standard time calculations (simple problems).

UNIT-IV

MATERIALS MANAGEMENT:
Objectives, Inventory – functions, types, associated costs, inventory controltechniques-ABC and VED analysis. Stores Management and Stores Records. Purchasemanagement duties ofpurchase of manager, associated forms, purchase procedure, methods of purchasing. Introduction to production planning and control (PPC) Objectives of PPC, Functions of PPC

UNIT-V

QUALITY CONTROL:
Meaning, process control, SQC control charts, single, double and sequential sampling, Introduction to TQM. Job Evaluation and merit rating: introduction-Job evaluation-objectives, benefits and limitations of job evaluation-methods of job evaluation.

Text Books:

1. DR. Ravi Shankar: Industrial Engineering and management/Galgotia publications pvt. Ltd.
2. Khanna O.P.: Industrial Engineering

Reference Books:
1. Industrial engineering and operations management by S.K. Sharma and Savita Sharma.
2. T.R. Banga : Industrial Engineering and Management
3. M. Mahajan: Industrial engineering and production management, DhanpatRai& Co.

Course Title	Fundamentals of RADAR Engineering					Open Electives		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE408	**OE**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	-	--	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:
To gain the knowledge about radar subsystems, their performance and key functions.
To provide the in depth knowledge and issues related various tracking radars.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Understand the essential principles of operation of radar systems.
CO 2	Describe the various Radar components
CO 3	Analyze different Radar systems
CO 4	Analyze the different Tracking methods

UNIT-I
Fundamentals: Nature of Radar, Maximum Unambiguous Range, Radar Waveforms, Radar block diagram and operation, Radar frequencies, Applications of Radar, simple form of radar range equation. Integration of Radar pulses, Radar cross-Section of targets, PRF.

UNIT-II
Radar components: RF amplifier, TWT, CFA, Modulators, Mixers-Conversion loss, Noise figure, Types of Mixers, Duplexers-Branch type, Balanced and Solid state Duplexers, Displays-CRT displays, A, B, C, E-scopes, PPI, RHI.

UNIT-III
Radar systems: Doppler Effect, CW Radar – Block Diagram, Isolation between Transmitter and Receiver, Non-zero IF Receiver, Receiver Bandwidth Requirements, Applications of CW radar, FMCW radar, multiple frequency C.W radar.

UNIT-IV
MTI and Pulse Doppler radar: Introduction, Principle, MTI Radar with - Power Amplifier Transmitter and Power Oscillator Transmitter, Delay Line Cancellers – Filter Characteristics, Blind Speeds, Double Cancellation, Staggered PRFs. Range Gated Doppler Filters. MTI Radar Parameters, Limitations to MTI Performance. Non-coherent MTI, MTI versus Pulse Doppler radar.

UNIT-V
Tracking Radar: Tracking with Radar, Sequential Lobing, Conical Scan, Monopulse Tracking Radar – Amplitude Comparison Monopulse (one- and two- coordinates), Phase Comparison Monopulse. Target Reflection Characteristics and Angular Accuracy. Tracking in Range, Acquisition and Scanning Patterns. Comparison of Trackers.

Text Books:

1. Merrill I.Skolnik, “Introduction to Radar Systems”, 2^{nd} edition-TMH 1980.

2. N.S. Nagaraja, “Elements of electronic navigation, 2^{nd} edition-TMH 1996.

Course Title	Biomedical Instrumentation					Minor Degree		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2091409	**EC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	-	--	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:
To Understand the functioning of Human Cell and its electrical characteristics
To Understand the functioning of cardiovascular measurement and circulatory System of heart
CO3: Describe various bioelectrodes
To Describe Organization of cell and various potentials
To Analyze the electrical hazards that may occur during the usage of medical instruments.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand the functioning of Human Cell and its electrical characteristics
CO 2	Understand the functioning of cardiovascular measurement and circulatory System of heart
CO 3	Describe various bioelectrodes
CO 4	Describe Organization of cell and various potentials
CO 5	Analyze the electrical hazards that may occur during the usage of medical instruments.

UNIT I
Components of Medical Instrumentation System: Bio-amplifier, Static and dynamic characteristics of medical instruments. Bio-signals and characteristics. Problems encountered with measurements from human beings.
UNIT II
Organization of cell: Derivation of Nernst equation for membrane Resting Potential Generation and Propagation of Action Potential, Conduction through nerve to neuro-muscular junction.

UNIT III
Bio Electrodes: Bio-potential Electrodes-External electrodes, Internal Electrodes. Biochemical Electrodes.Mechanical function, Electrical Conduction system of the heart, Cardiac cycle. Relation between electrical and mechanical activities of the heart. Pacemaker, Defibrillator

UNIT IV
Cardiac Instrumentation Blood pressure and Blood flow measurement: Specification of ECG machine. Einthoven triangle, Standard 12-lead configurations, Therapeutic equipment, Shortwave diathermy.
Respiratory Instrumentation: Mechanism of respiration, Spirometry, Pnemuotachograph Ventilators.

UNIT V
Physiotherapy and Electrotherapy Equipment: High frequency heat therapy, Short wave Diathermy, Microwave Diathermy, Ultrasonic Therapy Unit, Electro diagnostic/ Therapeutic Apparatus, Pain relief through electrical stimulation, Diaphragm pacing by Radio-frequency

for the treatment of chronic ventilator insufficiency, Bladder stimulators.

Patient electrical safety: Types of hazards, natural protective mechanism, leakage current, patient isolation, hazards in operation rooms, grounding conditions in hospital environment.

Text Books:

1. Leslie Cromwell and F.J. Weibell, “Biomedical Instrumentation andMeasurements “,E.A. Pfeiffer, PHI, 2nd Ed, 1980.
2. John G. Webster, “Medical Instrumentation, Application and Design”,John Wiley,3rd Ed., 1998.

Reference Books:

1. L.A. Geoddes and L.E. Baker, “ Principles of Applied Biomedical Instrumentation”, John Wiley,1975.
2. R.S. Khandpur, “ Hand-book of Biomedical Instrumentation”, TMH, 2nd Ed.,2003.
3. Mackay, Stuart R., “Biomedical Telemetry”,–John Wiley,1968.
4. M. Armugam, “Biomedical Instrumentation”, Anuradha agenciespublications.

Course Title	Digital Circuits					**Minor Degree**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2091410	**EC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	-	--	3	40	60	100
Mid Exam Duration: 90 Min					**End Exam Duration: 3Hrs**			

Course Objectives:
To provide fundamentals of number systems and Boolean Algebra.
To learn the design of combinational and sequential circuits.
To teach various memories and PLDs.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Understand various number systems and binary codes.
CO 2	Understand the postulates, theorems and properties of Boolean algebra.
CO 3	Describe the correlation between the Boolean expression and their corresponding logic diagram.
CO 4	Analyze Combinational & sequential logic circuits.
CO 5	Solve Switching functions using Programmable Logic Devices.

UNIT-I
Number Systems & Codes: Overview of number systems –complement representation of negative numbers- binary arithmetic, binary codes, code conversion, error detecting & error correcting codes –Hamming codes.

UNIT-II
Boolean Algebra and Minimization of Switching Functions: Fundamental postulates of Boolean Algebra - Basic theorems and properties –Canonical and Standard forms- Minimal SOP and POS forms ,Algebraic simplification, digital logic gates –universal gates-Multilevel NAND/NOR realizations. The K- map method, tabulation method.

UNIT-III
Combinational Logic Design: Design using conventional logic gates, Half and Full Adders, Subtractors, Serial and Parallel Adders, Encoder, Decoder, Multiplexer, De-Multiplexer, Realization of switching functions using multiplexer, Parity bit generator, Code-converters, Hazards and hazard free realizations.

UNIT-IV
Sequential Logic Design: Synchronous and Asynchronous sequential circuits, Flip-flops-Triggering and excitation tables, Flip flop conversions, shift registers, Design of Synchronous and Asynchronous counters, Ring and Johnson counters. Finite state machines (Mealy Model, Moore Model) and their representation, Designing synchronous Sequential circuits like Serial Binary adder, Sequence detector.

UNIT-V
Semiconductor Memories and Programmable Logic Devices: ROM- Internal structure, Static RAM and Dynamic RAM. Basic PLD‟s-ROM, PROM, PLA, and PAL, Realization of

Switching functions using basic PLD"s. Concept of PLD"s like CPLDs and FPGAs.

Text Books:

1. ZVI Kohavi, Switching & Finite Automata theory –, TMH, 2ndEdition.
2. Morris Mano, "Digital Design", PHI, 3rd Edition, 2006.
3. A. Anand Kumar, "Switching Theory & Logic Design", 2008, PHI.

Reference Books:

1. R. P. Jain, "Modern digital Electronics", Tata McGraw Hill, 4th edition, 2009.
2. W.H. Gothmann, "Digital Electronics- An introduction to theory and practice", PHI, 2nd edition, 2006.
3. D.V. Hall, "Digital Circuits and Systems", Tata McGraw Hill,1989
4. William I. Fletcher, "An Engineering Approach to Digital Design", PHI.
5. Charles H. Roth, "Fundamentals of Logic Design", Thomson Publications, 5th Edition,2004.
6. John M. Yarbrough, "Digital Logic Applications and Design", Thomson Publications,

Course Title	Python Programming (Open Elective Course -IV)					B. Tech VII Sem (R20) CSE		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE508	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Mins					**End Exam Duration: 3Hrs**			

Course Objectives:
Understand programming skills using basics of Python language
Acquire basics of how to use collection data types of python language.
To Introduce the object-oriented programming concepts.
To understand Python Libraries NumPy and Pandas.
To design a client server model using network Programming in python.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Demonstrate and acquire knowledge on usage of Data types, operators, input and output statements in python programming.
CO 2	Identify the right sequences of python language in problem solving.
CO 3	Apply object-oriented features to solve real time applications
CO 2	Analyze the given problem and develop python program to solve the problem
CO 4	Able to use Numerical Python (NumPy) Libraryd for data processing.
CO 5	Apply network programming features of python for Internet applications

UNIT-I

Introduction: Data Types, Object References, Collection Data Types, Logical Operations, Control Flow Statements, Arithmetic Operators, Input/Output, Creating and Calling Functions.

UNIT-II

Collection Data Types: Sequence Types, Set Types, Mapping Types, Iterating and Copying Collections, Control Structures, Exception Handling, Custom Functions, Modules and packages.

UNIT-III

File Handling and OOP: Writing and Parsing Text Files, Object Oriented Approach, Concepts and Terminology, Attributes and Methods, Inheritance and Polymorphism, Using properties to control attribute access, creating complete fully integrated data types.

UNIT-IV

NumPy Basics: The NumPy ndarray, Creating ndarray, Data Types for ndarray, Operations between Arrays and Scalars, Basic Indexing and Slicing, Boolean Indexing, Universal Functions, Data Processing using Arrays.

UNIT-V

Introduction to Internet Programming: What is Client/Server Architecture? Sockets: Communication End points, Network Programming in Python: Socket() Module Function, Socket Object Built-In Methods, creating a TCP Server, creating a TCP Client. [Text Book 4]

Text Books:

1. Programming in Python 3, A complete Introduction to Python Language by Mark

Summerfield, Pearson Publications, second edition, 2018
2. Core python programming by Wesley J Chun, Prentice Hall, Second edition.
3. Python for Data Analysis by Wes McKinney, O'Reilly, First Edition.
4. Core Python Applications Programming by Wesley J. Chun, Third Edition.

Reference Books:

1. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher.
2. Learning python, Mark Lutz, O'Reilly publications,5th edition, 2013
3. Python: The complete reference by Martin C Brown, McGraw-Hill Publication, 2018.
4. Core python programming by Dr. R. Nageswara Rao, Dreamtech press, second edition, 2018.

<table>
<tr><td>Course Title</td><td colspan="4">Cloud Computing
(Open Elective Course -IV)</td><td colspan="3">B.Tech VII Sem (R20) CSE</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE509</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exam s</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To explain the history of different computing paradigms.
To Know about issues and virtualization in cloud
To introduce the various levels of Cloud Services and applications that can be achieved by the cloud.
To know about cloud access and security issues.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Recall different Computing Paradigms and overview of cloud computing.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understanding the Cloud Computing Architecture, network connectivity and cloud migration strategy.</td></tr>
<tr><td>CO 3</td><td colspan="8">Explain and characterize different cloud deployment models, service models.</td></tr>
<tr><td>CO 4</td><td colspan="8">Understanding virtualization, Programming models and Software Development in Cloud Computing.</td></tr>
<tr><td>CO 5</td><td colspan="8">Understanding Cloud Service Providers AWS and Microsoft cloud Services.</td></tr>
</table>

UNIT-I

Computing Paradigms, Cloud Computing Fundamentals, Motivation for Cloud Computing: The Need for Cloud Computing. Defining Cloud Computing: NIST Definition of Cloud Computing, Computing Is a Service, Cloud Computing Is a Platform. Principles of Cloud computing: Five Essential Characteristics, Four Cloud Deployment Models, Three Service Offering Models, Cloud Ecosystem, Requirements for Cloud Services, Cloud Application, Benefits and Drawbacks.

UNIT-II

Cloud Computing Architecture and Management: Cloud Architecture, Anatomy of the Cloud, Network Connectivity in Cloud Computing, Applications on the Cloud, Managing the Cloud, Migrating Application to Cloud.

UNIT-III

Cloud Deployment Models: Private Cloud, Public Cloud, Community Cloud, Hybrid Cloud.
Cloud Service Models: Infrastructure as a Service, Platform as a Service, Software as a Service, Other Cloud Service Models.

UNIT-IV

Virtualization: Introduction, Virtualization opportunities, Approaches to Virtualization, Hypervisors, From Virtualization to cloud computing.
Programming Models in Cloud: Cloud Application Development Platforms: Windows Azure, Google App Engine, Force.com, Manjrasoft Aneka.
Software Development in Cloud: Introduction, Different perspectives on SaaS development, New challenges, Cloud aware software development using PaaS technology.

UNIT-V

Cloud Services : Using Amazon Web Services – Understanding AWS, AWS Components and Services, Working with the Elastic Compute Cloud (EC2), Amazon Storage Systems, Amazon Database Services, Using Microsoft Cloud Services – Exploring Microsoft Cloud Services, Defining the Windows Azure Platform.

Text Books:

1. Barrie Sosinsky, “Cloud Computing Bile” Wiley publishing.
2. Judith Hurwitz, R Bloor, M.Kanfman, F.Halper “Cloud Computing for Dummies”, Wiley India Edition, First Edition.
3. Rajkumar Buyya, James Broberg, Andrzej M. Goscinski ”Cloud Computing: Principles and Paradigms”, Wiley Publication,2011.
4. K.Chandrasekaran, Essentials of Cloud Computing, CRC Press, 2015.

Reference Books:

1. Danielle Ruest and Nelson Ruest, “Virtualization: A Beginners’s Guide”, McGraw Hill, 2009.
2. Tom White, “Hadoop: The Definitive Guide”, O’RIELLY Media 2009.
3. Nikos Antonopoulos, Lee Gillam, Cloud Computing: Principles, Systems and Applications, Springer, 2012.

<table>
<tr><td>Course Title</td><td colspan="4">DATA ANALYTICS WITH PYTHON (Open Elective Course – IV)</td><td colspan="4">B.Tech. VII Sem (R20UG) AI&ML</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours / Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE3907</td><td rowspan="2">OEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3 Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
Understand programming skills using basics of Python language
To introduce the object-oriented programming concepts.
Acquire basics of how to translate problem into object-oriented form
To understand object-oriented programming concepts, and apply them in solvingproblems.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Demonstrate and acquire knowledge on usage of Data types, operators, input andoutput statements in python programming.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the given problem and develop python program to solve the problem.</td></tr>
<tr><td>CO 3</td><td colspan="8">Able to use proper iterative statements in problem solving.</td></tr>
<tr><td>CO 4</td><td colspan="8">Entity the right sequence to solve the real-world problems.</td></tr>
<tr><td>CO 5</td><td colspan="8">Apply object-oriented features to solve real time applications.</td></tr>
</table>

UNIT - I

Features of python, Execution of a python program, comments, identifiers and variables, classification of data types, keywords, constants, Naming conventions in python, Operators and expressions, operator precedence and associativity, input and output statements.

UNIT - II

Control statements: simple if, if..else, nested if, if..elif..else statement. **Loops:** while loop, for loop, nested loops, break, continue, pass and assert statements, Arrays in python, Strings and their operations.

UNIT - III

Functions: define and calling a function, return statement, formal and actual arguments, local and global variables, passing arguments to function, anonymous functions, example programs on functions, recursion.

UNIT - IV

Sequences: Lists, Tuples, Sets, Dictionaries, Operations and methods on Tuples, Lists, Dictionaries.
Files: Types of files, opening file, closing a file, write data into a file, read data from a file.

UNIT - V

Introduction to OOPS: Introduction to class and objects, self-variable in python, constructor, types of variables and methods, Inheritance and polymorphism, abstract class.

Text Books:

1. Core python programming by Wesley J Chun, Prentice Hall, Second edition.
2. Introduction to Computation and Programming using Python, by John Guttag, PHI Publisher.
3. Learning python, Mark Lutz, O'Reilly publications, 5th edition, 2013.

4. Core python programming by Dr. R. Nageswara Rao, Dreamtech press, second edition, 2018

Reference Books:

1. Python: The complete reference by Martin C Brown, McGraw-Hill Publication, 2018.
2. Programming Python, Mark Lutz,4th Edition, O'Reilly publications.
3. Dive into Python, Mark Pilgrim, A Press Media, LLC.

Course Title	WEB DESIGNING USING PHP (Open Elective Course – IV)				B.Tech. VII Sem (R20UG) AI&ML		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
20OE3908	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:
Familiarize the tags of HTML.
Write backend code in PHP language and writing optimized front end code HTML and Java Script.
Understand, create and debug database related queries and Create test code to validate the applications against client requirement.

Course Outcomes: On successful completion of this course, the students will be able to	
CO1	Enumerate the Basic Concepts of Markup Languages.
CO2	Develop web Applications using CSS and different page layout.
CO3	Make use of decisions, loops, strings in PHP
CO4	Make use of functions, creating HTML forms with PHP.
CO5	Accessing database through PHP.

UNIT – I

Structuring Documents for the Web: Introducing HTML and XHTML, Basic Text Formatting, Presentational Elements, Phrase Elements, Lists, Editing Text, Core Elements and Attributes, Attribute Groups.
Links and Navigation: Basic Links, Creating Links with the Element, Advanced E- mail Links.
Images, Audio, and Video: Adding Images Using the error! File name not specified Element, Using Images as Links Image Maps, Choosing the Right Image Format, Adding Flash, Video and Audio to your web pages.
Tables: Introducing Tables, Grouping Section of a Table, Nested Tables, Accessing Tables.
Forms: Introducing Forms, Form Controls, Sending Form Data to the Server.
Frames: Introducing Frameset, Element, Creating Links between Frames, setting a Default Target Frame Using Element, Nested Framesets, Inline or Floating Frames with.

UNIT – II

Cascading Style Sheets: Introducing CSS, where you can Add CSS Rules.
CSS Properties: Controlling Text, Text Formatting, Text Pseudo Classes, Selectors, Lengths, Introducing the Box Model.
More Cascading Style Sheets: Links, Lists, Tables, Outlines, the focus and activate Pseudo classes Generated Content, Miscellaneous Properties, Additional Rules, Positioning and Layout with CSS.
Page Layout: Understating the Site's Audience, Page Size, Designing Pages, coding your Design, Developing for Mobile Devices.
Design Issues: Typography, Navigation, Tables, Forms.

UNIT – III

Introducing PHP – What is PHP? Why PHP use? Evolution of PHP, Installing PHP, Other ways to run PHP, Creating your first script.
PHP Language Basics – Using variables, Understanding Data Types, Operators and Expressions, Constants.
Decisions and Loops – Making Decisions, Doing Repetitive Tasks with Looping, Mixing Decisions and Looping with HTML.
Strings – Creating and Accessing Strings, Searching Strings, Replacing Text with Strings, Dealing with Upper and Lowercase, Formatting Strings.

UNIT – IV
Arrays – Creating Arrays, Accessing Array Elements, Looping Through Arrays with for-each, Working with Multidimensional Arrays, Manipulating Arrays.
Functions – What is a Function? Why Functions are useful? Calling Functions, Working with Variable Functions, writing your own Functions, Working with References, Writing Recursive Functions.
Handling HTML Forms with PHP – How HTML form works, Capturing Form Data with PHP, Dealing with Multi-Value Fields, Generating Web Forms with PHP, Storing PHP Variables in Forms, Creating File Upload Forms, Redirecting After a Form Submission.

UNIT – V
Working with Files: Getting Information on Files, Opening and Closing Files, Reading and Writing to Files, Copying, Renaming, and Deleting Files.
Working with Databases and MySQL – Database Architectures, Database Models, Starting the MySQL Server, Setting Up the MySQL root Password, making a Connection, choosing a Database, creating a New Database, Reading Data, creating a Table, Adding Data to a Table, Reading Data from a Table, Updating Data in a Table, Deleting Data from a Table, Deleting Tables and Databases, Handling Errors.

Text Books:
1. Jon Duckett, Beginning HTML, XTML, CSS and JavaScript
2. Matt Doyle, Beginning PHP 5.3 (Wrox – Wiley Publishing)

Reference Books:
1. Chris Bates, Web Programming
2. Ralph Moseley and M. T. Savaliya, Developing Web Applications
3. P.J. Deitel & H.M. Deitel, Internet and World Wide Web How to program
4. W. Jason Gilmore, Beginning PHP and MySQL From Novice to Professional

<table>
<tr><td>Course Title</td><td colspan="4">OPERATIONS RESEARCH (R20)</td><td colspan="3">OPEN ELECTIVE - IV</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE617</td><td rowspan="2">Open Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>--</td><td>--</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Minutes</td><td colspan="4">End Exam Duration: 3Hours</td></tr>
<tr><td colspan="9">Course Objectives:
The course is intended to identify and develop operations research models, understand the mathematical tools to solve optimization problems and develop a report that describes the model, the solving techniques and analyze the results.</td></tr>
</table>

Course Outcome: On successful completion of this course, the students will be able to	
CO 1	**Understand** various concepts of Operations research.
CO 2	**Apply** linear programming to optimization techniques.
CO 3	**Discuss** Transportation problem.
CO 4	**Solve** Assignment problem.
CO 5	**Distinguish** a game situation from a pure individual's decision problem and to explain concepts of players, strategies, payoffs, rationality.

UNIT I: Introduction to Operations research

Introduction, Models of Operations research, Advantages of Operations research, Limitations of Operations research

UNIT II: Linear Programming

Linear programming, Assumptions of linear programming, Properties of linear programming solution, Development of LP models, Graphical method, Simplex method.

UNIT III: Transportation Problem

Transportation problem, Mathematical model for transportation problem, Types of transportation problem, Starting solutions: North- West corner rule, Least cost method, Vogel's approximation method.

UNIT IV: Assignment Problem

Assignment problem – Hungarian method.

UNIT V: Game Theory

Introduction to Game Theory, Properties of a Game, Characteristics of Game Theory, Classification of Games, The Maximin-Minimax Principle, Two-Person and Zero-Sum Game, Games with Mixed Strategies, Method of finding out odds.

Text books:

1. Operations Research by N.K.Tiwari, Shishir K. Shandilya Prentice-Hall of India.
2. Operations Research by R. Pannerselvam, PHI Publications, 2nd Edition, 2012
3. Fundamentals of Operations Research, Prism publishers, Ackoff Russell LSasieni Maurice W.
4. Introduction to Operations Research, Cengage Publishers, Ecker Joseph Gkupferschmid Michael.

Reference Books:

1. Engineering Optimization by Singiresu S. Rao New Age International Publishers.
2. Operations Research by Kanthi Swarup, P.K.Gupta and Manmohan, S. Chand & Sons, 2004.
3. Introduction to Operations Research, TMH Publishers, Hiller Fredrick S, Lieberman Gerald J, Nag Bodhibr.
4. Introduction to Operations Research a Computer Oriented algorithmic, Gillett Billy E.

Course Title	FUNDAMENTALS OF QUANTUM COMPUTATION AND NANO PHOTONICS				OPEN ELECTIVE - 4		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**	
180E2618	**BSC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End lab Exams**	**Total**
		3	**0**	**0**	**3**	30	70	100
					End Exam Duration: 3Hrs			

COURSE OBJECTIVES:

This course outlines physically the intuitive concepts of quantum computation and nanophotonics using the concept of optical near-fields.
2.Physics of information processing; quantum error correction; quantum communication, Optical near-field is an electromagnetic field that mediates the interaction between nanometric materials used for the realization of novel photonic devices, fabrication techniques, and systems.
Prior knowledge of quantum mechanics and photonics is helpful.

Course Outcomes: Upon completion of the course, the student will be able to:

CO1	**Explain** the concepts of Quantum mechanics.
CO2	**Understanding** the basic concepts of quantum computation.
CO3	**Identify** the different implementations of quantum computers.
CO4	**Analyze** the nanophotonics and its true nature
CO5	**Classify** the Interconnections for nanophotonics

UNIT –I: Quantum Mechanics

Introduction to Matter Waves - de Broglie Hypothesis - Heisenberg Uncertainty Principle - Schrodinger’s time independent wave equation - Significance of wave function.

UNIT –II: Quantum Computing
Basic concepts of quantum mechanics – Stern - Gerlach Experiment - Qubits – Measurements – Gates - Quantum no-cloning and Teleportation.
UNIT -III: Error Correction and Implementations

Quantum Error-Correction - three-qubit bit flip code - five-qubit code - General properties of quantum error-correction.
First Experimental Implementations - Quantum optics implementations -NMR quantum information processing.

UNIT -IV: Nanophotonics

Photons and Electrons: Similarities and Differences - Confinement – Propagation-free space, Forbidden Zone: Tunneling.

UNIT – V: Nanophotonic systems

Nanotechnology- Photonics - Nanophotonics - Optical Nanomaterials - Nanoparticle Coatings - Sunscreen Nanoparticles - Self-Cleaning Glass - Fluorescent Quantum Dots – Nanobarcodes.

Text Books:

1. Quantum Computing Basics and Concepts by **S. M. Girvin - arXiv , 2013**
2. *Principles of Nanophotonics by* Motoichi Ohtsu, Kiyoshi Kobayashi, Tadashi Kawazoe, Takashi Yatsui and Makoto Naru -New York, USA: CRC Press-Taylor & Francis Group, 2008.
3. Paras. N. Prasad, Nanophotonics. New Jersey, USA:John Wiley & Sons Inc.,2004

Reference Books:

1. Quantum Computing by **John Watrous - University of Calgary , 2006**
2. Basic Concepts in Quantum Computing by **Artur Ekert, Patrick Hayden, Hitoshi Inamori – ar Xiv , 2000**
3. An Introduction to Quantum Computing for Non-Physicists" Eleanor Rieffel FX Palo Alto Labratory and Wolfgang Polak Consultant FX Palo Alto Laboratory.

<table>
<tr><td>Course Title</td><td colspan="5">Green Chemistry and Technology</td><td colspan="3">B. Tech.
(Open Elective-IV)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE619</td><td rowspan="2">Open Elective</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To make students aware of how chemical processes can be designed, developed and run in a sustainable way.
Students acquire the competence to think of chemistry as a sustainable activity</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand the tolls & Principles of Green Chemistry</td></tr>
<tr><td>CO 2</td><td colspan="8">Knowledge of applications of green routes for synthesis of chemicals</td></tr>
<tr><td>CO 3</td><td colspan="8">Synthesis of biocatalysts using different techniques</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze about trends of solvent free chemical reactions</td></tr>
<tr><td>CO 5</td><td colspan="8">Better realization about reflections of Green Chemistry on sustainable development initiatives.</td></tr>
</table>

Unit-1: Fundamentals of Green Chemistry:
Discussion of the current state of chemistry and the environment and the definition of green chemistry. An introduction to the tools of green chemistry and its fundamental principles.

Unit-2: Principles of Green Chemistry:
Prevention of waste / by-products, Hazardous products Designing of safer chemicals-Selection of appropriate solvents and starting materials- Use of protecting groups and catalysis- Designing of biodegradable products.

UNIT-3: Catalysis for Green Chemistry:
Use of biocatalysts- Biochemical Oxidation, Biochemical Reduction, Modified biocatalysts-transition metal catalysis-Simmons-Smith reaction, Heak reaction, Ullmann's coupling.

UNIT-4: Synthesis of green chemistry
a) Solvent Free Reactions: Solvent free techniques- Reactions on solid mineral supports, Phase Transfer Catalysis- C-alkylation, N-alkylation.
b) Ultrasound assisted green synthesis Introduction to ultrasound assisted green synthesis, Hydroboration, Bouveault reaction.

UNIT-5: Applications of Green Chemistry
Importance of Green chemistry in Sustainable development. Applications in Pharmaceutical Industry, Nanoscience, Chemical industry, Colour, Paper, polymer, Solar cells & in agriculture field.

Textbooks:

1. Engineering Chemistry, Fundamentals and Applications, Shikha Agarwal

2. Green Chemistry: Theory & Practice, Oxford University Press, Oxford publication, 1998
3. Green chemistry, Stanley E. Manahan, ChemChar Research, Inc publishers 2005.
4. Introduction to Green Chemistry, Second edition, Albert Matlack, CRC Press 2016
5. **References:**

<table>
<tr><td>Course Title</td><td colspan="4">Creative Writing</td><td colspan="3">OPEN ELECTIVE – IV</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE620</td><td rowspan="2">HUM</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Internal Assessment</td><td>External Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:
To acquaint the learners with ideas related to creative writing including the art, the craft and the basic skills required for a creative writer
To help learners to understand the principles of creative writing and the distinction between the literary genres
To explain the differences in writing for various literary and social media
To hone the creative and critical faculties of learners
To enable learners to put into practice the various forms of creative writing that they have studied through the course

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Distinguish between the literary genres
CO 2	Write for various literary and social media
CO 3	Critically appreciate various forms of literature
CO 4	Make innovative use of their creative and critical faculties
CO 5	Seek employment in various creative fields

Unit I: Fundamentals of Creative Writing: (6 Hours)
Meaning and Significance of Creative Writing - Genres of Creative Writing: poetry, fiction, non-fiction, drama and other forms - Research for Creative Writing

Unit II: Elements of Creative Writing :(8 Hours)
Main elements of creative writing- Vocabulary improvement- often used Latin expressions in English- Idiomatic expressions.

Unit III: Forms of Creative Writing: (8 Hours)
Dialogue writing - Note making/Note taking - Short story writing - Expansion of an Idea / Proverb -Creative writing for marketing - Self-Narrative Writing

Unit IV: New Trends in Creative Writing (8 Hours)
Web Content Writing and Blog Writing- Script Writing- Journalistic Writing – Copywriting- Graphic Novel- Flash Fiction

Unit V: Figurative Language
Literary Devices- Importance of figurative language in creative writing- Most common literary devices- Remedial grammar.

References:

1. Creative Writing: A Beginner's Manual AnjanaNeira Dev. AnuradhaMarwah, Swati Pal Delhi,
2. Pearson Longman, 2009.

3. Abrams, M.H. Glossary of Literary Terms. Boston: Wadsworth Publishing Company,2005.
4. Elements of Literature: Essay, Fiction, Poetry, Drama, Film. Robert Scholes, Nancy R. Comley, Carl H. Klaus, Michael Silverman Delhi, OUP, 2007.

CourseTitle	**Materials Management**					**B. Tech. Open Elective - IV**		
CourseCode	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE621	Open Elective (OEC)	**L**	**T**	**P**	**C**	**ContinuousInternal Assessment**	**End Exam**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 Min						**End Exam Duration: 3Hrs**		

Course Objectives: The objective of the course is
To understand how the knowledge of materials management can be an advantage to logistics and supply chain operations.
To sensitize the students on the materials management functions – Planning, Purchase, Controlling, Storing, Handling, Packaging, Shipping and Distributing, and Standardizing
To realize the importance of materials both in product and service.
Use of TQM, JIT and SCM in managing materials.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Remembering the concepts of purchases, vendors, materials handling, inventory types etc.
CO 2	An understanding of basic concepts in Materials management and modern trends in materials management
CO 3	Analyze the processes of vendor management, material handling, ABC analysis and EOQ etc...
CO 4	An understanding of principle of materials handling and evaluation of material handling performance.
CO 5	Able to apply the techniques of inventory management.

Unit - I
Purchase Management: Overview, Purchase organization, Ethical Concepts in purchases, PurchaseParameters, purchase Methods. International Purchasing, International purchasing procedure.
Unit - II

Vendor Management: Vendor Evaluation - factors, advantages and disadvantages, parameters. Vendormanagement process. Recent trends in Vendor management
Unit - III
Materials Handling: Handling Principles, handling costs, unit load concept, flow pattern,

materialhandling equipment's, evaluation of materials handling performance, safety in materials handling.

Unit - IV

Inventory Management: Types of Inventory, Costs Associated with Inventory, Inventory Control, Selective Inventory Control, Economic Order Quantity, ABC Analysis, Safety Stocks, Inventory Management Systems, Forecasting Techniques, Material Requirement Planning.

Unit - V

Computers in Materials Management: Introduction, Role of Computers in Materials Management: Advantages and Disadvantage of Computer in Materials Management, Materials Planning: Need for Materials Planning, Techniques of Materials Planning.

Text Book:

1. Material Management by K. ShridharaBhat

Reference Books:

2. Purchasing and Materials Management, P Gopalkrishnan,
3. Materials Management - An Integrated Approach, P Gopalkrishnan, M. Sundaresan, PHI.
4. Materials Management, Procedures, Text and Cases, A K Datta, PHI.
5. Production & Operation Management by K Ashwathappa, K ShridharaBhat

Course Title	Internship					B.Tech VII SEM EEE (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2002710	**Internship (INT)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**0**	**1.5**	**100**	**00**	**100**

Course Objectives: The main objective of the course is to learn
Develop and improve business skills in communication, technology, quantitative reasoning, and teamwork
Observe and participate in business operations and decision-making
Meet professional role models and potential mentors who can provide guidance, feedback, and support.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Assess interests and abilities in their field of study and Integrate theory and practice.
CO 2	Develop communication, interpersonal and other critical skills in the job interview process.
CO 3	Acquire employment contacts leading directly to a full-time job following graduation from college.
CO 4	Identify and carry out performance objectives related to their job assignment.

<table>
<tr><td>Course Title</td><td colspan="5">Skill Advanced Course
(Introduction to Machine Learning using Python)</td><td colspan="3">B.Tech VII SEM EEE (R20)</td></tr>
<tr><td>Course Code</td><td>Category</td><td colspan="3">Hours/week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">2002711</td><td rowspan="2">Skill Course
SC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End Exams</td><td>Total</td></tr>
<tr><td>1</td><td>-</td><td>2</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="9">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To create awareness on machine learning
- To understand significance of notebooks for machine learning applications
- To understand the supervised, unsupervised and reinforced algorithms
- To know the architecture of ANN and deep neural networks.

Course Outcomes: On successful completion of this course, the students will be able to

CO 1	Understand fundamentals of Machine Learning
CO 2	Able to develop a machine learning model using notebooks
CO 3	Apply concepts of Machine learning in real time problems
CO 4	Develop ANN and deep neural network models for real time applications

List of Experiments

1. Introduction on Machine Learning
2. Data Preprocessing
3. Supervised Machine Learning

3.1 Simple Linear Regression
3.2 Multiple Linear Regression
3.3 Polynomial Linear Regression
3.4 Support Vector Machine
3.5 Decision Tree Regression
3.6 Random Forest Regression
3.7 Regression model selection

4. Classification

4.1 Logistic Regression
4.2 K-Nearest Neighbors (K-NN)
4.3 Support Vector Machine (SVM)
4.4 Kernel SVM
4.5 Naive Bayes
4.6 Decision Tree Classification
4.7 Random Forest Classification
4.8 Classification model selection

5. Clustering

5.1 K-Means Clustering
5.2 Hierarchical Clustering

6. Artificial Neural network

6.1 Feedforward neural network
6.2 Back propagation neural network

Text Books:

1. AurélienGéron, “Hands-On Machine Learning with Scikit-Learn and TensorFlowConcepts,Tools, and Techniques to Build Intelligent Systems”, O’reilly publishers, 2017
2. Chris albon, “Machine Learning with Python cookbook”, O’reilly publishers, 2018

Reference Books:

1. Oliver Theobald, “Machine Learning For Absolute Beginners”, A Plain English Introduction (2nd Edition)
2. John Paul Mueller and Luca Massaron, “Machine Learning (in Python and R) For Dummies”(1st Edition)

B.Tech VIII SEM EEE (R20)

Course Title	**Project Work**					**B.Tech VIII SEM EEE (R20)**		
Course Code	**Category**	**Hours / Week**			**Credits**	**Maximum Marks**		
2002801	**PROJ**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**--**	**12**	**40**	**60**	**100**
Internship in Industry						**--**	**--**	**--**

Course Objectives: The objective of the course is to,
Develop and conduct appropriate experimentation, analyze and interpret data, and useengineering judgment to draw conclusions.
Acquire and apply new knowledge as needed, using appropriate learning strategies.
Apply knowledge of probability and statistics to applications in electrical engineering..

Course Outcomes: On successful completion of this course, the students will be able to,

CO 1	Demonstrate a sound technical knowledge of their selected project topic.
CO 2	Understand problem identification, formulation and solution.
CO 3	Design engineering solutions to complex problems utilizing a systemsapproach.
CO 4	Communicate with engineers and the community at large in written an oralform.
CO 5	Demonstrate the knowledge, skills and attitudes of a professional engineer.