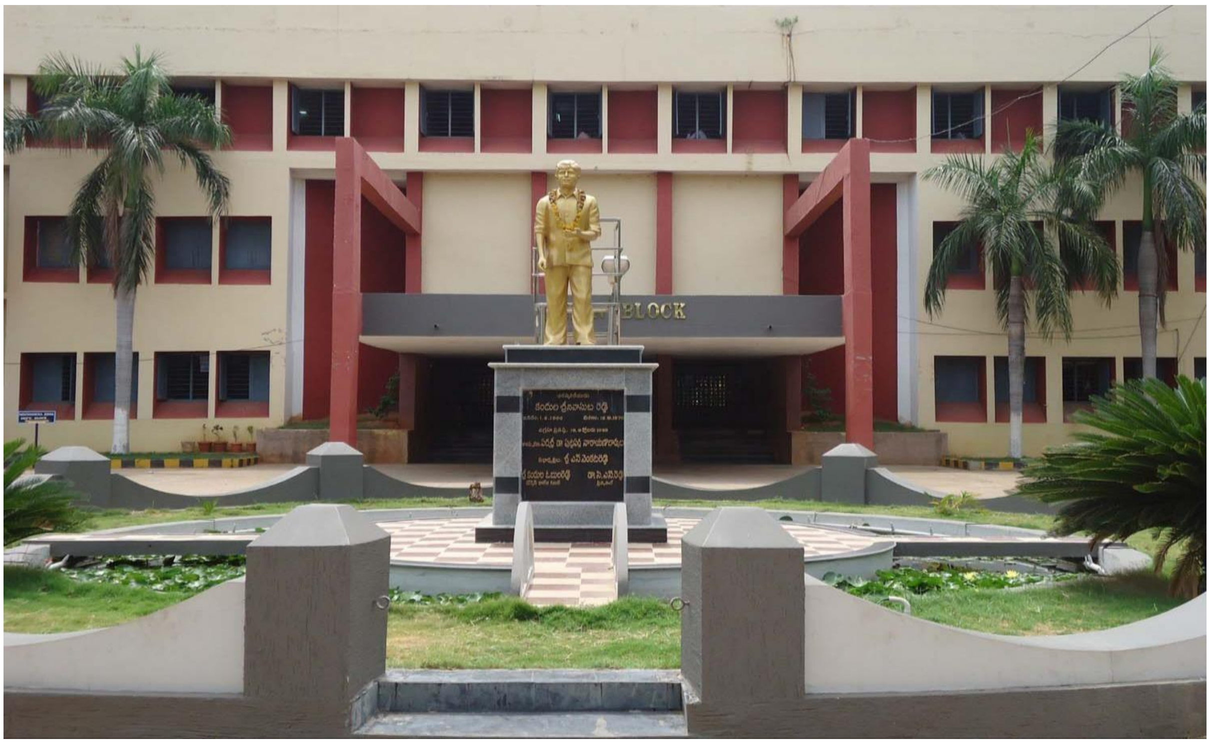
Regulations, Curriculum and Syllabus for

UG Programs in Engineering (R20UG)

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

MECHANICAL 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)

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.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION

To evolve as a department of high repute in Mechanical Engineering and allied fields through effective teaching, learning process and research activities, operating with a sense of professional and social responsibility.

MISSION

M1: To produce Mechanical Engineers with sound knowledge through quality teaching-learning process and well-designed curriculum.

M2: To induce critical thinking attitude and inculcate the use of modern tools through inter-disciplinary research and develop entrepreneurial skills through industry-institute interaction.

M3: To provide opportunities/platforms for students to nurture leadership abilities and ethical values.

PROGRAM EDUCATIONAL OBJECTIVES

PEO1: To apply engineering principles to develop products, processes or knowledge to solve mechanical and associated engineering problems for successful career in mechanical engineering and allied fields.

PEO2: To pursue higher education, research and development and engage in the process of life-long learning.

PEO3: To demonstrate leadership qualities, professional ethics, and communication skills and adapt current technologies to meet the societal requirements.

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: To apply their knowledge in the domain of engineering mechanics, thermal and fluid sciences to solve engineering problems utilizing advanced technology.

PSO2: To successfully apply the principles of design, analysis and implementationof mechanical systems/processes which have been learned as a part of the curriculum.

PSO3: To Develop and implement new ideas on product design and development with thehelp of modern CAD/CAM tools, while ensuring best manufacturing practices.

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 duration that 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 Civil Engineering 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 no credits 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 a scheduled 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's minor area of study

1.20 *Honours*: An Academic honour conferred on achieving 20 extra credits in one's major 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 regulations will 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 four academic 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 each branch 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. The credits assigned to subjects shall be given in curriculum. The total number of credits for entire course is 160 for all branches.

5.5 *Curriculum and Syllabus*: The curriculum and syllabus for first and second semesters is 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 in designing 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 allowed to 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 listed in curriculum and additional subjects required for achieving honours/ minor degree. Excepting first semester, the registration for a semester shall be done during a specified week after end examinations of previous semester. In first semester, the registration 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 six working 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 to that semester, ii) has cleared all fees to the Institute, library and hostel of previous semester, 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 and 60 marks for End examination totalling 100 marks.

7.2.2 For laboratory/drawing/project work subjects, the allocation is 40 marks for internal 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 or sudden quiz and assignments assessment marks.

If any student abstains for any midterm test, she or he will be awarded zero marks for that midterm test. If any student fails to submit any assignment within 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 questions and all questions shall be answered. However, each question can have internal choice (either or type question). Generally, each question shall test one 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. While some questions may test student's understanding of the subject, there shall be questions that imply connect to real world applications. A variety of questions can 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 are obtained 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. Late submissions 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 be done 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, and comprehensive 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 be evaluated 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, she or 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 by a letter grade that corresponds to absolute marks earned in that subject. Each letter grade 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 a subject 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 of that 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
$\geq$ 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 all credit-bearing subjects of a semester. SGPA is calculated as the weighted average of Grade 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 subject and
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. CGPA is 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 semester and 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 to be 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 E in that subject. If a student receives fail grade F or *Ab* in any subject, she or he must register 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 the opportunity arises and pass that subject. The supplementary exam will be conducted for 30 marks covering the entire syllabus and student is deemed to have passed in the subject if she or he earns 12 marks (40% marks) in the supplementary exam, 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 or he fulfils the attendance requirement.

10.2 A student shall be promoted from current semester to succeeding semester on satisfying 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 a semester 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-periods conducted 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 less than 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 the performance 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 at least 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 grade either 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 be removed 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 two MOOCs, 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 the concerned 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 all semesters, 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.

DEPARTMENT OF MECHANICAL ENGINEERING

VISION & MISSION

VISION:

To evolve as a department of high repute in Mechanical Engineering and allied fields through effective teaching, learning process and research activities, operating with a sense of professional and social responsibility.

MISSION:

M1: To produce Mechanical Engineers with sound knowledge through quality teaching-learning process and well-designed curriculum.

M2: To induce critical thinking attitude and inculcate the use of modern tools through inter-disciplinary research and develop entrepreneurial skills through industry-institute interaction.

M3: To provide opportunities/platforms for students to nurture leadership abilities and ethical values.

PROGRAMME OUTCOMES

PEO1: To apply engineering principles to develop products, processes or knowledge to solve mechanical and associated engineering problems for successful career in mechanical engineering and allied fields.

PEO2: To pursue higher education, research and development and engage in the process of life-long learning.

PEO3: To demonstrate leadership qualities, professional ethics, and communication skills and adapt current technologies to meet the societal requirements.

PROGRAM EDUCATIONAL OBJECTIVES

PROGRAMME OUTCOMES

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **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.
3. **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.
4. **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.
5. **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.
6. **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.

7. **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.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **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.
11. **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.

12 **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

PSO 1: To apply their knowledge in the domain of engineering mechanics, thermal and fluid sciences to solve engineering problems utilizing advanced technology.

PSO 2: To successfully apply the principles of design, analysis and implementation of mechanical systems/processes which have been learned as a part of the curriculum?

PSO 3: To Develop and implement new ideas on product design and development with the help of modern CAD/CAM tools, while ensuring best manufacturing practices.

Course Structure

I Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2021101	Linear Algebra and Calculus	BS	3	0	0	40	60	3
2	2023102	Chemistry	BS	3	0	0	40	60	3
3	2005103	C-Programming & Data Structures	ES	3	0	0	40	60	3
4	2014104	Basic Electrical & Electronics Engineering	ES	3	0	0	40	60	3
5	20EW105	Engineering Workshop	ES	0	0	3	40	60	1.5
6	2005106	IT Workshop	ES	0	0	3	40	60	1.5
7	2023107	Chemistry Lab	BS	0	0	3	40	60	1.5
8	2005108	C-Programming & Data Structures Lab	ES	0	0	3	40	60	1.5
9	2014109	Basic Electrical & Electronics Engineering Lab	ES	0	0	3	40	60	1.5
Total				**12**	**0**	**15**	**360**	**540**	**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 and Vector Calculus	BS	3	0	0	40	60	3
2	20AP202	Applied Physics	BS	3	0	0	40	60	3
3	2024203	Communicative English	HS	3	0	0	40	60	3
4	2005204	Material Science	ES	3	0	0	40	60	3
5	2003205	Engineering Drawing	ES	1	0	2	40	60	2
6	2003206	Engineering Drawing Lab	ES	0	0	2	40	60	1
7	20AP207	Applied Physics Lab	BS	0	0	3	40	60	1.5
8	2024208	Communicative English Lab	HS	0	0	3	40	60	1.5
9	2005209	Material Science Lab	ES	0	0	3	40	60	1.5
10	20MC211	Universal Human Values	MC	3	0	0	30	00	0.0
Total				**16**	**0**	**13**	**390**	**540**	**19.5**

III Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2003301	Fundamentals of Statistics and Dynamics.	ES	3	0	0	40	60	3
2	2003302	Fluid Mechanics &Hydraulic Machinery	ES	3	0	0	40	60	3
3	2003303	Manufacturing Processes	PC	3	0	0	40	60	3
4	2003304	Engineering Thermodynamics	PC	3	0	0	40	60	3
5	2003305	Mechanics of Materials	ES	3	0	0	40	60	3
6	2003306	Fluid Mechanics &Hydraulic Machinery Lab	ES	0	0	3	40	60	1.5
7	2003307	Manufacturing Technology Lab	PC	0	0	3	40	60	1.5
8	2003308	Mechanics of Materials Lab	ES	0	0	3	40	60	1.5
9	2003309	**Skill Oriented Course – I** CATIA	SC	1	0	2	40	60	2
10	20993M1	Environmental Science	MC	3	0	0	40	60	0
Total				**19**	**0**	**11**	**400**	**600**	**21.5**

IV Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2021401	Numerical Methods &Probability	BS	3	0	0	40	60	3
2	2003402	Applied Thermodynamics	PC	3	0	0	40	60	3
3	2003403	Kinematics of Machines	PC	3	0	0	40	60	3
4	2003404	Machine Tools	PC	3	0	0	40	60	3
5	2025405	**Humanities Elective- I** (Business Economics and Accounting for Engineers)	HS	3	0	0	40	60	3
6	2003406	Applied Thermodynamics lab	PC	0	0	3	40	60	1.5
7	2003407	Manufacturing Technology Lab-II	PC	0	0	3	40	60	1.5
8	2003408	Computer Aided Machine Drawing.	PC	0	0	3	40	60	1.5
9	2003409	**Skill Oriented Course – II** CNC Programming and Simulation.	SC	1	0	2	40	60	2
Total				**16**	**0**	**11**	**360**	**540**	**21.5**

V Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2003501	Heat Transfer	PCC	3	0	0	40	60	3
2	2003502	Design of Machine Members	PCC	3	0	0	40	60	3
3	2003503	Metrology and Measurements	PCC	3	0	0	40	60	3
	Professional Elective Course -I								
4	2003504	Alternative Fuels and Emission Control in Auto motives	PEC-I	3	0	0	40	60	3
	2003505	Automation & Robotics							
	2003506	Tool Design							
	2003507	Power Plant Engineering							
	2003508	Non Destructive Testing (NDT)							
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: **Electrical and Electronics Engineering**								
	20OE201	Modern Control Theory	OEC-1	3	0	0	40	60	3
	20OE202	Programming Fundamentals for Numerical Computations	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	2003514	Metrology and Measurements Laboratory	PCC	0	0	3	40	60	1.5
7	2003515	Heat Transfer Laboratory	PCC	0	0	3	40	60	1.5
8	2003516	**(Skill oriented course– III)** ANSYS	SC	1	0	2	40	60	2
9	20MC509	Constitution of India	MC	2	0	0	40		
10	2003517	Socially Relevant Project	PROJ	0	0	0	100	00	1.5
		Total		**18**	**00**	**08**	**460**	**480**	**21.5**

VI Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2003601	Operations Research	PCC	3	0	0	40	60	3
2	2003602	Finite Element Methods (FEM)	PCC	3	0	0	40	60	3
3	2003603	Introduction to CADCAM	PCC	3	0	0	40	60	3
	Professional Elective Course –II (MOOCs)								
4	2003604	Dynamics of Machinery	PEC-II	3	0	0	40	60	3
	2003605	Solar and Wind Energy Systems							
	2003606	Computational Fluid Dynamics (CFD)							
	2003607	Six Sigma and Lean Manufacturing							
	2003608	Energy Auditing							
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: **Electrical and Electronics Engineering**								
	20OE203	Energy Conversion Systems	OEC-2	3	0	0	40	60	3
	20OE204	Smart Grid	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	2003609	Computer Aided Machining Laboratory	PCC	3	0	0	40	00	1.5
7	2003610	Computer Aided Drafting Laboratory	PCC	0	0	3	40	60	1.5
8	2003611	Solid Works	PCC	0	0	3	40	60	1.5
9	20246S4	Soft Skills Lab **(Skill Oriented Course)**	SC	1	0	2	40	60	2
10	20MC612	Management Organization Behavior	MC	2	0	0	40		
		Total		**18**	**00**	**11**	**400**	**540**	**21.5**

VII Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
Professional Elective Course -III									
1	2003701	Modern Manufacturing Methods	PEC-III	3	0	0	40	60	3
	2003702	Design for Manufacturing							
	2003703	Solar and Wind Energy Systems							
	2003704	Mechanical Behavior of Material’s							
	2003705	Total Quality Management							
Professional Elective Course -IV									
2	2003706	Automobile Engineering	PEC-IV	3	0	0	40	60	3
	2003707	Additive Manufacturing							
	2003708	Mechanical Vibrations							
	2003709	Material Characterization							
	2003710	Production and Operations Management							

		Professional Elective Course-V							
3	2003711	Vehicle Diagnosis and Control	PEC-V	3	0	0	40	60	3
	2003712	Mechatronics & MEMS							
	2003713	Design of Oil Hydraulics and Pneumatics							
	2003714	Refrigeration & Air Conditioning							
	2003715	Geometric Dimension and Tolerances							
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: **Electrical and Electronics Engineering**							
	20OE205	Intelligent Control Techniques	OEC-3	3	0	0	40	60	3
	20OE206	Electrical System Estimation & Costing	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 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: **Electrical and Electronics Engineering**								
	20OE207	Basics of Power Electronics	OEC-4	3	0	0	40	60	3
	20OE208	System Reliability Concepts	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	2003716	Internship	PROJ	0	0	0	100	--	3
8	20246SC	**Skill course –V** Advanced English Communication Skills	SC	1	0	2	40	60	2
		Total		**19**	**0**	**2**	**380**	**420**	**23**

VIII Semester

S.No	Subject Code	SUBJECT	SC	L	T	P	IM	EM	CR
1	2003801	Full Internship/Project Work	PROJ	0	0	0	40	60	12
		Total		**-**	**-**	**-**	**40**	**60**	**12**

B.Tech I SEM ME (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Linear Algebra & Calculus</td><td colspan="3">B.Tech ME 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">BS</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 will illuminate the students in the concepts of calculus and linear algebra.
• To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems 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">Develop the use of matrix algebra techniques that is needed by engineers for practical Applications.</td></tr>
<tr><td>CO 2</td><td colspan="8">Utilize mean value theorems to real life problems</td></tr>
<tr><td>CO 3</td><td colspan="8">Classify the functions of several variables which is useful in optimization techniques.</td></tr>
<tr><td>CO 4</td><td colspan="8">Evaluate multiple integrals.</td></tr>
<tr><td>CO 5</td><td colspan="8">Define Beta and Gamma functions.</td></tr>
</table>

Bridge Course: Limits, continuity, Types of matrices

UNIT -I

Rank of a matrix by Echelon form, Normal form. Solving system of homogeneous and non-homogeneous linear equations. Eigen values and Eigen vectors for real matrices – Cayley- Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley–Hamilton theorem. Diagonalization by orthogonal transformation.

UNIT -II

Mean Value Theorems: (08 Hours)

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: (10 Hours)

Partial derivatives, total derivative, chain rule, change of variables, Jacobians, Maxima andminima of functions of two variables – Lagrange’s method of undetermined multipliers.

UNIT -IV

Multiple Integrals: **(10 Hours)**

Evaluation of double integrals in Cartesian coordinates and polar coordinates – Change ofvariables in double integrals – Change the order of integration in double integrals – Evaluation oftriple integrals in Cartesian and polar coordinates – Change of variables between Cartesian, cylindrical and spherical polar coordinates.

UNIT -V

Beta and Gamma functions: **(08 Hours)**

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.
3. Introductory Linear Algebra with applications, Kolman, Bernard Hill, David R
4. Linear Algebra, Hoffman Kennethkunze Ray

Reference Books:

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

Course Title	**Engineering Chemistry**					**B.Tech ME I Sem (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2023102	**BS**	**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:

- 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

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

CO 1	Understand the basic quantum approach of Molecular orbital theory and calculation of bond order
CO 2	Remember the principle of Band diagrams in application of conductors and semiconductors.
CO 3	Compare the materials of construction for battery and electrochemical sensors.
CO 4	Explain the preparation, properties, and applications of thermoplastics & thermosetting, Elastomers & con ducting polymers
CO 5	Analyze the principles of spectroscopy and different application of analytical instruments.

UNIT- I

Water Technology (10 hrs)

Introduction –Soft Water and hardness of water, hardness of water by EDTA Method, Estimation of dissolved oxygen (Winkler's method)-Boiler troubles **–** Priming, foaming**,** scale and sludge, Caustic embrittlement, Industrial water treatment – specifications for drinking water, Bureau of Indian Standards (BIS) and World health organization (WHO) standards, ion- exchange processes - desalination of brackish water, reverse osmosis (RO) and electro dialysis.

Learning outcomes:

The student will be able to

- List the differences between temporary and permanent hardness ofwater (L1)
- Explain the principles of reverse osmosis and electrodialysis. (L2)
- Compare quality of drinking water with BIS and WHO standards. (L2)
- Illustrate problems associated with hard water - scale and sludge. (L2)
- Explain the working principles of different Industrial watertreatment processes (L2)

UNIT- II

Electrochemistry and Applications: (10 hrs)

Introduction to electrodes – concepts, electrochemical cell, Nernst equation, cell potential calculations. 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.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aeration cell corrosion, galvanic corrosion, metal oxide formation by dry electrochemical corrosion, Pilling Bed worth ratios and uses, Factors affecting the corrosion,Cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

Learning Outcomes:

At the end of this unit, the students will be able to

- Apply Nernst equation for calculating electrode and cell potentials (L3)
- Apply Pilling Bedworth rule for corrosion and corrosion prevention (L3)
- Demonstrate the corrosion prevention methods and factorsaffecting corrosion (L2)
- Compare different batteries and their applications (L2)

UNIT- III

Polymers and Fuel Chemistry: **(8 hrs)**

Introduction to polymers, Polymer dispersion index, functionality of monomers, Mechanism of chain growth, step growth and coordination polymerization.

Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of poly styrene. PVC and Bakelite.

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol Fuels **–** Typesof fuels, calorific value, numerical problems based on calorific value; Analysis of coal, **Liquid Fuels** refining of petroleum, fuels for IC engines, knocking and anti-knock agents, Octane and Cetane values, cracking of oils; alternative fuels- propane, methanol and ethanol, bio-fuels.

Learning Outcomes:

At the end of this unit, the students will be able to

- Explain different types of polymers and their applications (L2)
- Solve the numerical problems based on Calorific value(L3)
- Select suitable fuels for IC engines (L3)
- Explain calorific values, octane number, refining of petroleum andcracking of oils (L2)

UNIT-IV

Advanced Engineering Materials (10 hrs)

Refractories- Classification, Properties, Factors affecting the refractory materials andApplications.

Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils – Viscosity, Viscosity Index, Flash point, Fire point, Cloud point.

Building materials- Portland cement, constituents, phases and reactivity of clinker, Setting and Hardening of cement.

Learning Outcomes:

At the end of this unit, the students will be able to

- Identify the factors affecting the refractorymaterial(L3)
- Illustrate the functions and properties of lubricants (L2)
- Demonstrate the phases and reactivity of concrete formation (L2)
- Identify the constituents of Portland cement (L3)
- Enumerate the reactions at setting and hardening of the cement (L3)

UNIT- V:

Surface Chemistry and Applications: (10 hrs)

Introduction to surface chemistry, colloids, micelle formation, synthesis of colloids (Dispersion method), chemical and electrochemical method (chemical vapour deposition) of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, applications of colloids and nanomaterials –medicine.

Learning Outcomes:

At the end of this unit, the students will be able to

- Summarize the concepts of colloids, micelle and nanomaterials (L2)
- Explain the synthesis of colloids with examples (L2)
- Outline the preparation of nanomaterials and metal oxides (L2)
- Identifythe application of colloids and nanomaterials in medicine.(L2)

Text Books:

1. A textbook of Engineering chemistry by Shashi Chawla, Dhanpat Rai & Co publications
2. Atkins' Physical Chemistry, Peter Atkins, Julio de Paula and James Keeler, Oxford University Press, 2010.
3. Textbook of Polymer Science, Third Edition, Fred W. Billi Meyer, TR, A Wiley-Inter Science Publications
4. An Introduction to Electrochemistry, Glasstone, Arihant Publications.

Reference Books:

1. Textbook of Engineering Chemistry, Jain and Jain, Dhanpat Rai & Co publications, 2013
2. New Concise Inorganic Chemistry, 5th Edition, J. D. Lee, Oxford University Press, 2008.
3. Principles of Instrumental Analysis, 6th edition, Douglas A. Skoog, Cengage Publications.
4. Advanced Inorganic Chemistry, Cotton F Albert, Wilkinson Geoffrey, Prism Publications

<table>
<tr><td>Course Title</td><td colspan="5">C Programming & Data Structures</td><td colspan="3">B.Tech I Sem (CSE, EEE, ME) (R20)
B.Tech II Sem (CE, ECE)</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
(I Sem)
2005203
(II Sem)</td><td rowspan="2">ES</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:
• The course aims to provide exposure to problem-solving through programming
• It aims to train the student to the basic concepts of the C programming language
• Gain knowledge of 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 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>

UNIT -I

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

UNIT-II

Arrays: Introduction, Declaration and initialization of 1D and 2D arrays, **Functions:** types of functions, Recursion and argument passing, pointers, storage allocation, pointers to functions, expressions involving pointers, Storage classes – auto, register, static, extern. **Strings:** string handling functions, and Command line arguments.

UNIT-III

Pointers: Introduction to pointers, declaring and initialization of pointer variable, 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 of data structures, stacks and queues, representation of a stack, stack related terms, operations on a stack, implementation of a stack, evaluation of arithmetic expressions, infix, prefix, and postfix notations, evaluation of postfix expression, conversion of expression from infix to postfix, recursion, queues - various positions of queue, representation of queue, insertion, deletion, searching operations.

Searching and sorting: linear search, binary search, bubble (exchange) 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. Fundamentals of Data Structures in C, Ellis Horowitz, SartajSahni, SusanAnderson-Freed, Computer Science Press.
2. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A.Ananda Rao, Pearson Education
3. Rema The raja, Programming in C, second edition, Oxford.
4. E. Bal guru swamy, C Programming and Data structures, fourth Edition,McGraw-Hill.

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, SecondEdition.

<table>
<tr><td>Course Title</td><td colspan="5">Basic Electrical & Electronics Engineering
Part ‘A’: Basic Electrical Engineering
Part ‘B’: Electronics Engineering</td><td colspan="3">B.Tech ME 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">2014104</td><td rowspan="2">ES</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:
The objective of the course is to learn basics of DC and AC circuits, Electrical Machines, Transformers and Power Systems. Theory, construction, and operation of electronic devices, biasing of BJTs and FETs, design and construction of amplifiers, concepts & principles of logic devices.</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 basic fundamentals of DC & AC circuits, network reduction techniq machines and power system fundamentals
CO 2	Understand theory, construction, and operation of electronic devices, working ofdiodes and its applications, working of transistors, microcontrollers & their applications.
CO 3	Determine the currents, voltages using mesh and nodal analysis, Average and RMS values for different waveforms, equivalent circuit parameters using OC & SC test of single phase transformer.
CO 4	Obtain the EMF equation and characteristics of dc machines and Induction motor.
CO 5	Analyze small signal amplifier circuits to find the amplifier parameters
CO 6	Design small signal amplifiers using proper biasing circuits to fix up proper Q point

Part A: Basic Electrical Engineering

UNIT-I

DC Circuits: Electrical circuit elements (R - L and C) - Kirchhoff laws - Series and parallel connection of resistances with DC excitation. Superposition Theorem. Simple Numerical Problems.

AC Circuits: Representation of sinusoidal waveforms – Average and RMS values - phasor representation - real power - reactive power - apparent power - power factor - Analysis of single-phase ac circuits consisting of RL - RC - RLC series circuits, simple numerical problems.

UNIT-II

DC Machines: Principle and operation of DC Generator - EMF equations - OCCcharacteristics of DC generator – principle and operation of DC Motor – Torque equation

– Performance Characteristics of DC Motor, speed control (Flux & Armature control ofshuntmotor), Simple numerical problems.

Transformers: Principle and operation of Single Phase Transformer – Emf equation,equivalent circuit, OC and SC tests on transformer, simple numerical problems.

Induction Motor: Principle and operation of 3-phase Induction Motor [Elementarytreatmentonly].

UNIT-III

Basics of Power Systems: Typical AC power supply scheme – Generation of 3-phase supply, Definition of short, medium and long transmission lines – Concepts of AC & DC distribution system.

Text Books:

1. V.K. Mehta & Rohit Mehta, "Principles of Power System" – S.Chand – 2018.
2. V.D.TORO "Electrical Engineering Fundamentals".prentice hall India,1989
3. D. P. Kothari and I. J. Nagrath - "Basic Electrical Engineering" - Tata McGraw Hill -2010.
4. D.C. Kulashreshtha."Basic Electrical Engineering ',M C Graw hill,2009

Reference Books:

1. L.S.Bobrow ,"Fundamentals of electrical Engineering"..
2. E. Hughes - "Electrical and Electronics Technology" - Pearson - 2010.
3. C.L. Wadhwa – "Generation Distribution and Utilization of Electrical Energy", 3rd Edition, New Age International Publications
4. Fundamentals of Electrical Circuits Charles K. Alexander and Matthew ,N.O Sadiku ,MC Graw hill,5thEdition ,2013

Part 'B'- Electronics Engineering

UNIT-I

Diodes and Applications: Semiconductor Diode, Diode as a Switch& Rectifier, Half Wave and Full Wave Rectifiers with and without Filters; Operation and Applications of Zener Diode, LED,Photo Diode.

Transistor Characteristics: Bipolar Junction Transistor (BJT) – Construction, Operation, Amplifying Action, Common Base, Common Emitter and Common Collector Configurations, Operating Point, Biasing of Transistor Configuration; Field Effect Transistor (FET) – Construction, Characteristics of Junction FET, Concepts of Small Signal Amplifiers –CE & CC Amplifiers.

UNIT-II

Operational Amplifiers and Applications: Introduction to Op-Amp, Differential Amplifier Configurations, CMRR, PSRR, Slew Rate; Block Diagram, Pin Configuration of 741 Op-Amp, Characteristics of Ideal Op-Amp, Concept of Virtual Ground; Op-Amp Applications - Inverting, Non-Inverting, Summing and Difference Amplifiers, Voltage Follower, Comparator, Differentiator, Integrator.

UNIT-III

Digital Electronics: Logic Gates, Simple combinational circuits–Half and Full Adders, BCD Adder. Latches and Flip-Flops (S-R, JK and D), Shift Registers and Counters. Introduction to Microcontrollers and their applications (Block diagram approach only).

Text Books:

1. R.L.Boylestad& Louis Nashlesky, Electronic Devices &Circuit Theory, PearsonEducation,2007.
2. Principles of Electronics, V.K. Mehta, Rohit Mehta, S Chand.
3. Operational Amplifiers with Linear Integrated Circuits, William D. Stanley, 4^{th} Edition,Pearson.
4. R. P. Jain, Modern Digital Electronics,3^{rd} Edition, Tata Mcgraw Hill,2003.

Reference Books:

1. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, PrenticeHall,India, 2002.
2. R. S. Sedha, A Text Book of Electronic Devices and Circuits, S.Chand& Co, 2010.
3. Ramakanth A. Gayakwad, Op-Amps & Linear ICs, 4^{th}Edition, Pearson, 2017.
4. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and SystemDesign,2^{nd} Edition, Pearson, 2012.

<table>
<tr><td>Course Title</td><td colspan="5">Engineering Workshop</td><td colspan="3">B.Tech ME 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">20EW105</td><td rowspan="2">ES</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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• Sheet metal operations,
• Fitting
• Electrical house wiring skills
• Wood working</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 wood working skills in real world applications</td></tr>
<tr><td>CO 2</td><td colspan="8">Build different objects with metal sheets in real world applications</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply fitting operations in various applications</td></tr>
<tr><td>CO 4</td><td colspan="8">Apply different types of basic electric circuit connections</td></tr>
<tr><td>CO 5</td><td colspan="8">Use soldering and brazing techniques</td></tr>
</table>

WOOD WORKING:

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

Half – Lapjoint

Mortise and Tenonjoint

Corner Dovetail joint or Bridlejoint.

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) Conicalfunnel c)Elbowpipe d)Brazing

FITTING:

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

a) V-fit b)Dovetailfit c) Semi-circularfit d) square fitting

ELECTRICAL WIRING:

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

a) Parallelandseriesb) Twowayswitch c)Godownlighting d) Tubelight

e) Threephasemotor f) Soldering ofwires

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

Text Books:

1. Mechanical Workshop Practice, K.C. John, 2nd Edition, PHI.
2. Engineering Workshop, Lindsay White, Oxford University Press.

Reference Books:

1. Mechanical Experiments and Workshop Practice, G.S. Sawhney, IK International Pvt Ltd.

<table>
<tr><td>Course Title</td><td colspan="4">IT Workshop</td><td colspan="3">B.Tech I Sem
(CSE, ME) (R20)
B.Tech II Sem
(CE,EEE,ECE)</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">2005106
(I Sem)
2005206
(II Sem)</td><td rowspan="2">ES</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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To make the students know about the internal parts of a computer, assembling anddissembling a computer from the parts, preparing a computer for use by installing the operating system.
- To provide Technical training to the students on Productivity tools like Word processors, Spreadsheets, Presentations and Latex.
- To learn about Networking of computers and use Internet facility for Browsing and Searching

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

CO 1	Disassemble and Assemble a Personal Computer and prepare the computer readyuse.
CO 2	Prepare the Documents using Word processors and Prepare spread sheets for calculations .using excel and also the documents using LAteX.
CO 3	Prepare Slide presentations using the presentation tool.
CO 4	Interconnect two or more computers for information sharing.
CO 5	Access the Internet and Browse it to obtain the required information.

Preparing your Computer

Task 1:

Learn about Computer: Identify the internal parts of a computer, and its peripherals. Representthe same in the form of diagrams including 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 trouble shoot the computer and identify working and non- working parts. Student should identify the problem correctly by various methods.

Task 3:

Install Operating system: Student should install Linux on the computer. Student 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 InternetTask 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 switch/hub and share information. Crimpling activity, logical configuration etc. should be done by the student. The entire process has to be documented.

Task 6:

Browsing Internet: Student should access the Internet for Browsing. Students should search the Internet for required information. Students should be able to create e-mail account and send email.
They should get acquaintance with applications like Facebook, skype etc. If 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 account.

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 colour, including images and tables in the word file, making page setup, copy and paste blockof 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 sheet and chapter pagesat 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, colours, 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, adjust 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 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).

Text Books:

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, PearsonEducation.
4. Networking your computers and devices, Rusen, PHI

Reference Books:

1. Trouble shooting, Maintaining & Repairing PCs, Bigelows, TMH.
2. Lamport L. LATEX: a document preparation system: user's guide and referencemanual, Addison-wesley; 1994.
3. The Complete Reference PC Hardware, Craige Zacker, John Rourke, Tata McGraw Hill.
4. Microsoft Office 365 & Office 2019 Introductory, Sandra Cable, Steven M. Freund, Ellen Monk,Susan L. Sebok, Joy L. Starks, and Misty E. Vermaat, Cengage.

<table>
<tr><th>Course Title</th><th colspan="5">Chemistry Lab</th><th colspan="3">B.Tech ME I Sem (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">2023107</td><td rowspan="2">BS</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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To verify the fundamental concepts with experiments.
• The student will have exposure to various experimental skills and hand-on experience which is very essential for an Engineering student.</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. Determination of Hardness of a groundwatersample.
2. Estimation of dissolved oxygen by Winkler's method
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 a polymer (Bakelite).
9. Determination of percentage of Iron in Cement sample by colorimetry
10. Estimation of Calcium in port land Cement
11. Preparation of nanomaterials by precipitation.
12. Adsorption of acetic acid by charcoal
13. Determination of percentage Moisture content in a coal sample
14. Determination of Viscosity of lubricating oil by Redwood Viscometer 1.
15. Determination of Viscosity of lubricating oil by Redwood Viscometer 2.

Text Books:

1. Vogel's Text book of Quantitative Chemical Analysis, J. Mendham et.al., Pearson Education, Sixth Edition, 2012.
2. Laboratory manual on Engineering Chemistry, Anupama Rajput, Dhanpat Rai& Co Publications.
3. Essentials of Experimental Engineering Chemistry, Shashichawla, DhanpatRai& Co Publications.

<table>
<tr><td rowspan="1">Course Title</td><td colspan="4">C Programming & Data Structures Lab</td><td colspan="3">B.Tech I Sem
(CSE, EEE,ME) (R20)
B.Tech II Sem (CE, ECE)</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">2005108
(I Sem)
2005208
(II Sem)</td><td rowspan="2">ES</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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- know how to write and debug programs
- know the principles of designing structured programs
- Write basic C programs using, Selection statements, Repetitive statements,
- Functions, Pointers, Arrays, Strings and structures
- To 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
CO 6	Represent data in arrays, strings and structures and manipulate them through aprogram
CO 7	Write programs on data structures like stack, queue, liked list, trees etc

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 grosss alary.

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***) ofa 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 appropriatemessages.

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

6. A character is entered through 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 ofintegers.

14. Write a C program to sort the list of elements using

a) Bubble Sort   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 ≤X are in one subset and elements ≥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 same then the string is called as 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 followingoperations 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 space sand 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 to

- **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 andfind the total marks of each student and print the result in the following format.

Roll No	Name	Sub1	Sub2	Sub3	Total marks	result
189Y1A0501	Kavya	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 onsingle linked list.

i) Creation ii) Insertion iii) Deletion iv) Traversal

29. Write a C program that uses functions to perform the following operations onDouble 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. Fundamentals of Data Structures in C, Ellis Horowitz, SartajSahni, SusanAnderson-Freed, Computer Science Press.
2. Programming in C and Data Structures, J.R.Hanly, Ashok N. Kamthane and A. AnandaRao, Pearson Education.
3. Rema Theraja, Programming in C, second edition,Oxford.
4. E. Balagurusamy, C Programming and Data structures, Fourth Edition,McGrawHill.

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. Yashavant Kanetkar, Let us C, 15th edition, BPBPublications.
4. Dr. P. Chenna Reddy, Computer Fundamentals and C Programming,Second Edition.

<table>
<tr><td>Course Title</td><td colspan="4">Basic Electrical & Electronics Engineering Lab
Part ‘A’: Basic Electrical Engineering Lab
Part ‘B’: Electronics Engineering Lab</td><td colspan="3">B.Tech (CE , ME &CSE)
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">2014109</td><td rowspan="2">ES</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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
The objective of the course is to verify KCL, KVL, superposition theorem, measurement of real& reactive power for RL & RC circuits, performance characteristics of DC machines and transformers. Analyze the characteristics of Diodes, BJT, MOSFET, UJT, design the amplifier circuits from the given specifications and verification of truth tables.</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 Kirchhoff’s laws, superposition theorem theoretically and practically for anygiven circuit, truth table for different logic gates and measure real & reactive power for RL & RC circuits.</td></tr>
<tr><td>CO 2</td><td colspan="8">Illustrate various characteristics of DC machines from the measured data(Practically).</td></tr>
<tr><td>CO 3</td><td colspan="8">Obtain the efficiency and regulation for single phase transformer</td></tr>
<tr><td>CO 4</td><td colspan="8">Learn the characteristics of basic electronic devices like PN junction diode, Zenerdiode & BJT</td></tr>
<tr><td>CO 5</td><td colspan="8">Analyze the application of diode as rectifiers, clippers and clampers and other circuits</td></tr>
</table>

Part A: Basic Electrical Engineering Lab

LIST OF EXPERIMENTS: -

Basic Electrical Engineering Lab (Any 5 experiments)

1. Verification of Kirchhoff laws
2. Verification of Superposition Theorem
3. Magnetization characteristics of a DC Shunt Generator
4. Speed control of DC Shunt Motor
5. OC & SC test of 1 – Phase Transformer

6. Load test on 1-Phase Transformer
7. Brake test on DC Shunt Motor
8. Measurement of Real & Reactive Power by single phase RL,RC circuits

Text Books:

1. V.K. Mehta & Rohit Mehta, “Principles of Power System” – S.Chand – 2018.
2. E. Hughes - “Electrical and Electronics Technology” - Pearson - 2010.
3. C.L. Wadhwa – “Generation Distribution and Utilization of Electrical Energy”, 3rd Edition, New Age International Publications.
4. D. P. Kothari and I. J. Nagrath - “Basic Electrical Engineering” - Tata McGraw Hill -2010.

Reference Books:

1. Fundamentals of Electrical Engineering-I, Don Johnson, University Press.
2. Basic Electrical Engineering, SK. Sahdev, Pearson.
3. Basic Electrical Engineering, Abhijith Chakrabarti, Sudipta Nath, Chandan Kumar Chanda, Tata McGraw Hill.
4. Basic Concepts of Electrical Engineering, Kuldeep Sahay, Shivendra Pathak, New Age International Publishers.

Part B: Electronics Engineering Lab

LIST OF EXPERIMENTS:-

Basic Electronics Engineering Lab (Any 5 experiments)

1. PN Junction diode characteristics A) Forward bias B) Reverse bias.
2. Zener diode characteristics and Zener as voltage Regulator.
3. Full Wave Rectifier with & without filter.
4. Wave Shaping Circuits. (Clippers & Clampers)
5. Input & Output characteristics of Transistor in CB / CE configuration.
6. Frequency response of CE amplifier.
7. Inverting and Non-inverting amplifiers using Op-AMPs.
8. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs.
9. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs.

Text Books:

1. R.L.Boylestad& Louis Nashlesky, Electronic Devices &Circuit Theory, PearsonEducation, 2007.
2. Principles of Electronics, V.K. Mehta, Rohit Mehta, S Chand.
3. Operational Amplifiers with Linear Integrated Circuits, William D. Stanley, 4th Edition, Pearson.
4. R. P. Jain, Modern Digital Electronics,3rd Edition, Tata Mcgraw Hill,2003.

Reference Books:

1. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, PrenticeHall, India, 2002.
2. R. S. Sedha, A Text Book of Electronic Devices and Circuits, S.Chand& Co, 2010.
3. Ramakanth A. Gayakwad, Op-Amps & Linear ICs, 4thEdition, Pearson, 2017.\
4. Raj Kamal, Microcontrollers: Architecture, Programming, Interfacing and SystemDesign, 2nd Edition, Pearson, 2012.

B.Tech II SEM ME (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Differential Equations and Vector Calculus</td><td colspan="3">B.Tech ME 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">BS</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 enlighten the learners in the concept of differential equations.
• To furnish the learners with basic concepts and techniques at plus two level to leadtheminto advanced level by handling various real world 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">Classify second and higher order liner D.E’s with constant coefficients.</td></tr>
<tr><td>CO 2</td><td colspan="8">Solve partial differential equations.</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the applications of partial differential equations.</td></tr>
<tr><td>CO 4</td><td colspan="8">Understand vector differentiation concepts.</td></tr>
<tr><td>CO 5</td><td colspan="8">Apply vector integration concepts.</td></tr>
</table>

UNIT- I

Linear differential equations of higher order (constant coefficients) :

Definitions, homogeneous and non- homogeneous, complimentary 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 constantsand 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.
4. Advanced Engineering Mathematics, Greenberg Michael D, Cengage Publishers.

Reference Books:

1. Higher Engineering Mathematics, B.V. Ramana, Mc. Graw Hill Education (India) Pvt. Ltd, New Delhi, 11th Edition, Reprint 2010.
2. A Text Book of Engineering Mathematics, N.P. Bali and Manish Goyal, Lakshmi Publications, Reprint 2008.
3. Applied Calculus, Hegarty John C.
4. Advanced Calculus, Widder V David, Pearson Publishers.

<table>
<tr><td>Course Title</td><td colspan="4">Engineering Physics</td><td colspan="3">B.Tech ME 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">20EP202</td><td rowspan="2">BS</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:

- To make a bridge between the physics in school and engineering courses.
- To identify the importance of the optical phenomenon i.e. interference, diffraction and polarization related to its Engineering applications
- To understand the mechanisms of emission of light, the use of lasers aslight sources for low and high energy applications, study ofpropagation of light wave through optical fibres along with engineering applications.
- To explain the significant concepts of dielectric and magnetic materials thatleads to potential applications in the emerging micro devices.
- To enlighten the concepts of Quantum Mechanics and to providefundamentals of de'Broglie waves, quantum mechanical wave equation and its applications, the importance of free electron theory and band theory of solids.
- Evolution of band theory to distinguish materials, basic concepts and transport phenomenon of charge carriers in semiconductors. To give animpetus on the subtle mechanism of superconductors using the concept of BCS theory and their fascinating applications.

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. (L2)
CO 2	Identify the wave properties of light and the interaction of energy with the matter (L3). Asses the electromagnetic wave propagation and its power in different media (L5).
CO 3	Understands the response of dielectric and magnetic materials to the applied electric and magnetic fields. (L3)
CO 4	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. (L2)
CO 5	Elaborate the physical properties exhibited by materials through the understanding of properties of semiconductors and superconductors. (L5)

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 ofOptical 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 – Clausius-Mossotti equation.

Magnetic Materials- Introduction to magnetic materials (Origin of magnetic moment ofan 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, 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 freeelectron 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 Tc superconductors – Applications of superconductors.

Text Books:

1. Engineering Physics – Dr. M.N. Avadhanulu & Dr. P.G. Krishnasagar,S. Chand and Company
2. Optics- Ajoy Ghatak , McGraw Hill Publishers,6th edition,1st January,2018.
3. Fundamental of Physics- Halliday, Resnick and Walker, Wiley publications.
4. Solid State Physics, Hall H E, paramount Publications.

Reference Books:

1. Engineering Physics – K.Thyagarajan, McGraw Hill Publishers
2. Semiconductor Devices-S.M.Sze , Wiley Publications.
3. Lasers & Non-linear Optics Nelkon M parker P, Arnold Heinemann Publications
4. Semiconductor physics and devices- Basic principle – Donald A, Neamen, Mc Graw Hill

<table>
<tr><td>Course Title</td><td colspan="5">Communicative English</td><td colspan="3">B.Tech ME 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">2024203</td><td rowspan="2">HS</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:

- Facilitate effective listening skills for better comprehension of academic lectures and English spoken by native speakers
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Help improve speaking skills through participation in activities such asrole 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
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing

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

CO 1	Retrieve the knowledge of basic grammatical concepts
CO 2	Understand the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English.
CO 3	Apply grammatical structures to formulate sentences and correct word forms.
CO 4	Analyze discourse markers to speak clearly on a specific topic in informal discussions.
CO 5	Evaluate reading/listening texts and to write summaries based on globalcomprehension of these texts.
CO 6	Create a coherent paragraph interpreting a figure/graph/chart/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 idea 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 Peace - 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 contextclues; 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 inacademic 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 Complexsentences; 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:** Writingstructured essays on specific topics using suitable claims and evidences.

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

Text Books:

1. Language and Life: A Skills Approach- I Edition 2019, Orient Black Swan
2. Oxford Learners Dictionary, 12th Edition, 2011
3. Norman Lewis Word Power Made Easy- The Complete Handbook for Building aSuperior Vocabulary (2014)
4. Speed Reading with the Right Brain: Learn to Read Ideas Instead of Just Wordsby David Butler.

Reference Books:

1. Bailey, Stephen. Academic writing: A handbook for international students.Routledge, 2014.
2. Chase, Becky Tarver. Pathways: Listening, Speaking and CriticalThinking. 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.

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

Course Title	Material Science				B.Tech ME II Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2003204	ESC	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:

- To teach the principles of physical metallurgy, i.e. crystallography of metals, constitution of alloys, phase diagrams.
- Expose commercially important metals and alloys (both ferrous and non ferrous) with engineering constraints.
- Explain the methods to change the properties of materials through heat treatment processes
- Familiarize properties and applications of ceramics, polymers and composite materials.
- Demonstrate the fundamental properties of nano-materials and their applications.

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

CO 1	Understand the importance of iron - iron carbide phase diagram
CO 2	Understand the importance of non-ferrous metals and alloys in engineering applications.
CO 3	Explain the principles of binary phases
CO 4	Utilize nonferrous metals and alloys in engineering.
CO 5	Understand the importance of Heat Treatment.

UNIT-I

Structure of Metals: Crystal Structures: Unit cells, Metallic crystal structures, Imperfection in solids: Point, Line, interstitial and volume defects; dislocation strengthening mechanisms and slip systems, critically resolved shear stress.

Constitution of Alloys: Necessity of Alloying, substitutional and interstitial solid solutions- Phase diagrams: Interpretation of binary phase diagrams and microstructure development; eutectic, peritectic, peritectoid and monotectic reactions. Iron-Iron-carbide diagram and microstructural aspects of ferrite, cementite, austenite, ledeburite, and cast iron.

Learning Outcomes:

At the end of this unit the student will be able to

- Understand the importance of material science in engineering.(L2)recall the definitions and terminology of crystallography. (L1) distinguish metals and alloys. (L4)
- Make use of the principles of construction of binary phase diagrams. (L3)identify various invariant reactions in binary phase diagrams. (L3)
- Know the concept of metallography in studying the microstructures of metals and alloys.(L2)

UNIT-II

Steels:

Plain carbon steels, use and limitations of plain carbon steels. AISI& BIS classification of steels. Classification of alloys steels. Microstructure, properties and applications of alloy steels- stainless steels and tool steels.

Cast irons:

Microstructure, properties and applications of white cast iron, malleable cast iron, grey cast iron, nodular cast iron and alloy cast irons.

Learning Outcomes:

At the end of this unit the student will be able to

- Classify various types of steels, their properties and applications. (l2)
- Identify various types of cast irons, their properties and applications. (l3)
- Compare steels and cast irons and their limitations in applications. (l3)

UNIT-III

Heat Treatment of Steels: Annealing, tempering, normalizing and hardening, isothermal transformation diagrams for Fe-Fe3C alloys and microstructure development. Continuous cooling curves and interpretation of final microstructures and properties- austempering, martempering, case hardening - carburizing, nitriding, cyaniding, carbo-nitriding, flame and induction hardening, and vacuum and plasma hardening

Learning Outcomes:

At the end of this unit the student will be able to

- Know the influence of heat treatment in modification of properties of steels. (l2)
- Develop a heat treatment cycle based on properties required. (l3)
- Comprehend the principles of surface hardening methods. (l2)

UNIT-IV

Non-ferrous Metals and Alloys: Microstructure, properties and applications of copper, aluminium, titanium, nickel and their alloys. Study of Al-Cu phase diagram

Learning Outcomes:

At the end of this unit the student will be able to

- Demonstrate various properties and applications of non-ferrous alloys. (l4)
- Differentiate between hardening of ferrous and non-ferrous alloys. (l4)

UNIT-V

Ceramics, Polymers and Composites: Structure, properties and applications of ceramics,polymers and composites. Introduction to super alloys and nanomaterials.

Learning Outcomes:

At the end of this unit the student will be able to

- Understand the properties of ceramics and their applications. (l2)
- Summarize the properties of polymers and composites and their use. (l2)
- Interpret the properties of nano materials and their applications. (l2)
- Identify the difference between the micro and nano scale materials and their uses. (L3)

Text Books:

1. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
2. R.Balasubramaniam, Callister's Material Science and Engineering, 2/e, Wiley India, 2014.
3. Introduction to Material science by Barry Royce Schlenker
4. Engineering material Science by Milton Ohring

Reference Books:

1. Y. Lakhtin, Engineering Physical Metallurgy, University Press of the Pacific, 2000.
2. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
3. L.H.VanVlack, Elements of Material Science and Engineering, 6/e, Pearson Education,2008.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.

Course Title	**Engineering Drawing**					**B.Tech ME II Sem (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003205	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		1	**0**	**2**	**2**	**40**	**60**	**100**
Mid Exam Duration: 90 Minutes					**End Exam Duration: 3Hrs**			

Course Objectives:

- Bring awareness that Engineering Drawing is the Language of Engineers.
- Familiarize how industry communicates technical information.
- Teach the practices for accuracy and clarity in presenting the technical information. Develop the engineering imagination essential for successful design

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	Know draw orthographic and isometric projections.
CO 5	Evaluate different methods of perspective view.

UNIT-I

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

a) Conic sections including the rectangular hyperbola- general method only,

b) Cycloid, epicycloids and hypocycloid 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 views 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 toorthographic 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 ofperspective view-methods of drawing perspective view-simple problems.

Text Books:

1. N.D.Bhatt, Engineering Drawing, 53/e, Charotar Publishers,2016.
2. K.C.John, Engineering Graphics, 2/e, PHI,2013
3. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right,2008.
4. Dhanajay A Jolhe, Engineering Drawing, Tata McGraw-Hill, Copy Right,2009
5. Interpreting Engineering DrawingsBook by Ted Branoff.
6. Mechanical Drawing: Board & CAD TechniquesBook by Jay D. Helsel.
7. A Textbook of Engineering Drawing: For Undergraduate ...Book by Addisu Dagne Zegeye

Reference Books:

1. Venugopal, Engineering Drawing and Graphics, 3/e, New Age Publishers,2000
2. Shah and Rana, Engineering Drawing, 2/e, Pearson Education,2009
3. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e, ScitechPublishers,Chennai, 2012.
4. K.C.John, Engineering Graphics, 2/e, PHI,2013
5. BasantAgarwal&C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill, Copy Right, 2008.
6. Sketch up for Dummies book by Bill Fane, Josh Reilly, and Mark Harrison

Additional Sources:

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

Course Title	Engineering Drawing Lab					B.Tech ME II Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003206	**ES**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**2**	**1**	**40**	**60**	**100**
					End Exam Duration: 3Hrs			

Course Objectives:

- Familiarize how industry communicates technical information.
- Teach the practices for accuracy and clarity in presenting the technical information.
- Develop the engineering imagination essential for successful design.
- Bring awareness that Engineering Drawing is the Language of Engineers
- Instruct the utility of drafting & modeling packages in orthographic and isometric drawings.
- Train the usage of 2D and 3Dmodeling.
- Instruct graphical representation of machine components

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

CO 1	Use computers as a drafting tool.
CO 2	Draw isometric and orthographic drawings using CAD packages
CO 3	Analyze orthographic drawings using CAD packages.

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 toorthographic projections - simple objects.

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

Text Books:

1. Basant Agarwal & C.M.Agarwal, Engineering Drawing, Tata McGraw-Hill,CopyRight, 2008.
2. K.C.John, Engineering Graphics, 2/e, PHI, 2013
3. K. Venugopal, V.Prabhu Raja, Engineering Drawing + Auto Cad, New AgeInternational Publishers.
4. Kulkarni D.M, AP Rastogi and AK Sarkar, Engineering Graphics with AutoCad,PHI Learning, Eastern Economy editions.

Reference Boo ks:

1. T. Jayapoovan, Engineering Graphics using Auto Cad, Vikas PublishingHouse
2. K.L.Narayana & P.Kannaiah, Engineering Drawing, 3/e,ScitechPublishers, Chennai, 2012.
3. Linkan Sagar, BPB Publications, Auto Cad 2018 Training Guide.
4. A Textbook of Engineering Drawing: For Undergraduate ...Book by Addisu Dagne Zegeye

Additional Sources:

1. Youtube: http-sewor,Carleton.cag, kardos/88403/drawings.htmlconicsections-online, red woods.edu

Course Title	Engineering Physics Lab					B.Tech ME II Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20EP207	**BS**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**3**	**1.5**	**40**	**60**	**100**
					End Exam Duration: 3Hrs			

Course Objectives:

- Understands the concepts of interference, diffraction and their applications.
- Understand the role of optical fiber parameters in communication.
- Recognize the importance of energy gap in the study of conductivity and Hall Effect in a semiconductor.
- Illustrates the magnetic and dielectric materials applications.
- Apply the principles of semiconductors in various electronic devices.

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

CO 1	Operate various optical instruments (L2)
CO 2	Estimate wavelength of laser and particles size using laser(L2)
CO 3	Evaluate the acceptance angle of an optical fiber and numerical aperture (L3)
CO 4	Estimate the susceptibility and related magnetic parameters of magnetic materials (L2)
CO 5	Apply the concepts of ultrasonics by acoustic grating (L2)

Note: In the following list, out of 15 experiments, any 12 experiments (minimum 10) must be performed in a semester

List of Engineering Physics Experiments

1. Determine the thickness of the wire using wedge shape method
2. Determination of the radius of curvature of the lens by Newton's ringmethod
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 tofind 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 –StewartGee’smethod.
10. Study the variation of B versus H by magnetizing the magnetic material (B-Hcurve)
11. To determine the resistivity of semiconductor by Four probe method
12. To determine the energy gap of a semiconductor

Text 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="5">Communicative English Lab</td><td colspan="3">B.Tech ME 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">2024208</td><td rowspan="2">HS</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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Students will be exposed to a variety of self instructional, learner friendly modes of language learning.
- Students will learn better pronunciation through stress, intonation and rhythm.
- Students will be trained to use language effectively to face interviews, group discussions, and public speaking.
- Students will be initiated into greater use of the computer in resume preparation, report writing, format making etc

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

CO 1	Listening and repeating the sounds of English Language
CO 2	Understand the different aspects of the English language, proficiency with emphasis on LSRW skills.
CO 3	Apply communication skills through various language learning activities
CO 4	Analyze the English speech sounds, stress, rhythm, intonation and syllable division for better listening and speaking comprehension
CO 5	Evaluate and exhibit acceptable etiquette essential in social and professional settings
CO 6	Create awareness on mother tongue influence and neutralize it in order to improve fluency in spoken English.

UNIT-I

- Listening Skills
- Phonetics
- Introducing oneself

UNIT-II

- Describing objects
- JAM / Interpretation of Hypothetical Situations
- Role play

UNIT-III

- Hypothetical situations (If…...... were)
- Elocution
- TED talks videos

UNIT-IV

- Visual Description
- Situational conversations

UNIT-V

- Oral Presentations
- PowerPoint presentations

Suggested software:

- Orell
- Walden Infotech
- Young India Films
- 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 CriticalThinking. Heinley ELT;2nd Edition, 2018.
3. Skillful Level 2 Reading & Writing Student's Book Pack (B1) MacmillanEducational.
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.comwww.englishinteractive.net

Course Title	**Material Science Lab**					**B.Tech ME II Sem (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003209	**ESC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		0	**0**	**3**	**1.5**	**40**	**60**	**100**
Mid Exam Duration: 2Hrs					**End Exam Duration: 3Hrs**			

Course Objectives:

- To understand the microstructure and hardness of engineering materials.
- To explain grain boundaries and grain sizes of different engineering materials.

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

CO 1	Differentiate various microstructures of ferrous and non-ferrous metals and alloys
CO 2	Differentiate various microstructures of ferrous and non-ferrous metals and alloys.
CO 3	Visualize grains and grain boundaries
CO 4	Importance of hardening of steels
CO 5	Differentiate hardness of super alloys, ceramics and polymeric materials

LIST OF SAMPLE EXPERIMENTS:

1. Calculate the following programs using Python
2. Metallography sample preparation
3. Microstructure of pure metals – Iron, copper and aluminum as per ASTM standards
4. Microstructure of low carbon steel, mild steel and high carbon microstructure of castirons.
5. Microstructure of non-ferrous alloys – aluminum, copper, titanium, nickel and theiralloys.
6. Hardenability of steels by Jominy End Quench Test.
7. Microstructure of heat treated steels.
8. Hardness of various untreated and treated steels.
9. Microstructure of ceramics, polymeric materials.
10. Microstructure of super alloy and nano-materials.
11. Hardness of ceramics, super alloys, nano-materials and polymeric materials (onesample on each)

Text Books:

1. Introduction to Material science by Barry Royce Schlenker
2. Engineering material Science by Milton Ohring
3. V.Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
4. R.Balasubramaniam, Callister's Material Science and Engineering, 2/e, Wiley India, 2014.

Reference Books:

1. Y. Lakhtin, Engineering Physical Metallurgy, University Press of the Pacific, 2000.
2. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
3. L.H.VanVlack, Elements of Material Science and Engineering, 6/e, Pearson Education, 2008.
4. George E.Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.
5. Material Science of Thin Films by Milton Ohring

<table>
<tr><td>Course Title</td><td colspan="5">Universal Human Values</td><td colspan="3">B.Tech ME 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">20MC211</td><td rowspan="2">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>3</td><td>0</td><td>0</td><td>0.0</td><td>40</td><td>--</td><td>40</td></tr>
<tr><td colspan="6">Mid Exam Duration: 90 Minutes</td><td colspan="3"></td></tr>
</table>

Course Objectives:

- Development of a holistic perspective based on self-exploration about themselves (human being), family, society and nature/existence.
- Understanding (or developing clarity) of the harmony in the human being, family, society and nature/existence.
- Strengthening of self-reflection.
- Development of commitment and courage to act.

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	Students are expected to become more aware of themselves, and theirsurroundings (family, society, nature).
CO 2	They would become more responsible in life, and in handling problems with sustainable solutions, while keeping human relationships and human nature in mind.
CO 3	They would have better critical ability.
CO 4	They would also become sensitive to their commitment towards what theyhave understood (human values, human relationship and human society).
CO 5	It is hoped that they would be able to apply what they have learnt to their ownself in different day-to-day settings in real life, at least a beginning would be made in this direction.

UNIT- I

Course Introduction - Need, Basic Guidelines, Content and Process for ValueEducation

- Purpose and motivation for the course, recapitulation from Universal HumanValues-I.
- Self-Exploration–what is it? - Its content and process; ‘Natural Acceptance’and Experiential Validation- as the process for self-exploration.
- Continuous Happiness and Prosperity- A look at basic Human Aspirations.
- Right understanding, Relationship and Physical Facility- the basic requirements for fulfillment of aspirations of every human being with their correct priority.

- Understanding Happiness and Prosperity correctly- A critical appraisal of thecurrent scenario.
- Method to fulfill the above human aspirations: understanding and living in harmony at various levels.

Include practice sessions to discuss natural acceptance in human being as the innateacceptance for living with responsibility (living in relationship, harmony and co-existence) rather than as arbitrariness in choice based on liking-disliking.

UNIT-II

Understanding Harmony in the Human Being - Harmony in Myself!

- Understanding human being as a co-existence of the sentient 'I' and thematerial'Body'
- Understanding the needs of Self ('I') and 'Body' - happiness and physicalfacility
- Understanding the Body as an instrument of 'I' (I being the doer, seer andenjoyer)
- Understanding the characteristics and activities of 'I' and harmony in 'I'
- Understanding the harmony of I with the Body: Sanyam and Health;correctappraisal of Physical needs, meaning of Prosperity in detail
- Programs to ensure Sanyam and Health.

Include practice sessions to discuss the role others have played in making material goods available to me. Identifying from one's own life. Differentiate between prosperity and accumulation. Discuss program for ensuring health vs dealing with disease

UNIT-III

Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

- Understanding values in human-human relationship; meaning of Justice (nine universal values in relationships) and program for its fulfilment to ensure mutual happiness; Trust and Respect as the foundational values of relationship
- Understanding the meaning of Trust; Difference between intention andcompetence
- Understanding the meaning of Respect, Difference between respect anddifferentiation; the other salient values in relationship
- Understanding the harmony in the society (society being an extension of family):Resolution, Prosperity, fearlessness (trust) and co-existence as comprehensive Human Goals
- Visualizing a universal harmonious order in society- Undivided Society, Universal Order- from family to world family.

Include practice sessions to reflect on relationships in family, hostel and institute as extended family, real life examples, teacher-student relationship, goal of education etc. Gratitude as a universal value in relationships. Discuss with scenarios. Elicit examples from students' lives.

UNIT-IV

Understanding Harmony in the Nature and Existence - Whole existence asCoexistence

- Understanding the harmony in the Nature
- Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature
- Understanding Existence as Co-existence of mutually interacting units in all-pervasive space
- Holistic perception of harmony at all levels of existence.

Include practice sessions to discuss human being as cause of imbalance in nature (film "Home" can be used), pollution, depletion of resources and role of technology etc.

UNIT-V

Implications of the above Holistic Understanding of Harmony on ProfessionalEthics

- Natural acceptance of human values
- Definitiveness of Ethical Human Conduct
- Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
- Competence in professional ethics: a. Ability to utilize the professional competence for augmenting universal human order b. Ability to identify the scope and characteristics of people friendly and eco-friendly production systems, c. Ability to identify and develop appropriate technologies and management patterns for above production systems.
- Case studies of typical holistic technologies, management models and production systems
- Strategy for transition from the present state to Universal Human Order: a. At the level of individual: as socially and ecologically responsible engineers,technologists and managers b. At the level of society: as mutually enriching institutions and organizations
- Sum up.

Include practice Exercises and Case Studies will be taken up in Practice (tutorial) Sessions eg. To discuss the conduct as an engineer or scientist etc.

Text Books:

1. 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
2. R R Gaur, R Asthana, G P Bagaria, “Teachers’ Manual for A Foundation Course in Human Values and Professional Ethics”, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2.
3. E. FSchumacher. “Small is Beautiful”.
4. Slow is Beautiful –Cecile Andrews

Reference Books:

1. Jeevan Vidya: Ek Parichaya, A Nagaraj, Jeevan Vidya Prakashan, Amar kantak,1999.
2. A. N. Tripathi, “Human Values”, New Age Intl. Publishers, New Delhi, 2004.
3. The Story of Stuff (Book).
4. Mohandas Karamchand Gandhi “The Story of My Experiments with Truth”
5. J C Kumarappa “Economy of Permanence”
6. Pandit Sunderlal “Bharat Mein Angreji Raj”
7. Dharampal, “Rediscovering India”
8. Mohandas K. Gandhi, “Hind Swaraj or Indian Home Rule”
9. India Wins Freedom - Maulana Abdul Kalam Azad
10. Vivekananda - Romain Rolland(English)
11. Gandhi - Romain Rolland (English)

B.Tech III SEM ME (R20)

<table>
<tr><th>Course Title</th><th colspan="4">Fundamentals of Statics and Dynamics</th><th colspan="3">B.Tech ME III Sem (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">2003301</td><td rowspan="2">ES</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- The student should understand the some fundamental aspects of Engineering Mechanics.
- To apply and to solve a few basic problems in engineering mechanics like static equilibrium of particles and rigid bodies.
- To Analyze trusses and friction, Properties of surfaces and volumes, Dynamic equilibrium of particles, Dynamic equilibrium of rigid bodies.

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

CO 1	Evaluate the resultant force and moment for given force system.
CO 2	Assess the forces in members of trusses, frames and problems related to friction.
CO 3	Determine the centroid of composite figures and centre of gravity of bodies .
CO 4	Determine area, moment of inertia and mass moment of inertia.
CO 5	Adapt the laws of motion, kinematics of motion and their interrelationship.

UNIT-I

BASIC CONCEPTS: System of Forces– Moment of Forces and its Application– Couples and Resultant of Force System- Equilibrium of system of forces- Free body diagrams – Types of Supports –Support reactions for beams with different types of loading – concentrated, uniformly distributed and uniformly varying loading.

UNIT- II

ANALYSIS OF PERFECT FRAMES: Types of frames – cantilever frames and simply supported frames – Analysis of frames using method of joints.

Friction force – Laws of sliding friction – equilibrium analysis of simple systems with sliding friction – wedge friction-. Rolling resistance -Translation and Rotation of Rigid Bodies – Velocity and acceleration – General Plane motion of simple rigid bodies such as cylinder, disc/wheel and sphere.

UNIT- III

CENTROID AND CENTER OF GRAVITY: Centroids of simple figures – Centroids of Composite figures – Centre of Gravity of bodies

STRESS: Rigid bodies and deformable solids – Tension, Compression and Shear Stresses.

UNIT- IV

AREA MOMENT OF INERTIA - Parallel axis and perpendicular axis theorems - Moments of Inertia of Composite Figures

MASS MOMENT OF INERTIA: Moment of Inertia of Simple solids, Moment of Inertia of composite masses.

UNIT- V

Kinematics: Introduction, Velocity, Acceleration, Equations of Motion in a Straight Line under uniform Acceleration, Rectilinear Motion Under Variable Accelerations.

Torsion formulation stresses and deformation in circular and hollows shafts – Stepped shafts– Deflection in shafts fixed at the both ends – Stresses in helical springs – Deflection of helical springs, carriage springs.

Text Books:

1. Fedrinand L.Singer , Engineering Mechanics – B.S. Publishers 2nd Edition.
2. Mechanics of materials by EP. Popov, Printice hall of india 2017.
3. A.Nelson, Engineering Mechanics-Statics and dynamics, , Tata McGraw-Hill Company, 2009.

Reference Books:

1. Timoshenko & Gere, Mechanics of Materials by, CBS, Revised Fourth Edition
2. B. Bhathacharya , Engineering Mechanics - Oxford University Publications, 2014.
3. Dr. R. K. Bansal ,Engineering Mechanics, Laxmi Publications,2005.

<table>
<tr><td>Course Title</td><td colspan="4">Fluid Mechanics & Hydraulic Machinery</td><td colspan="3">B.Tech ME III 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">2003302</td><td rowspan="2">ES</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
. The students completing this course are expected:
1. To give insight knowledge on fluid statics and fluid dynamics
2. To teach different types of fluid flow, and boundary layer phenomena
3. To teach operation and working principles of Turbo machinery, pumps and Turbines.</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 the Properties of Fluid Flow.</td></tr>
<tr><td>CO 2</td><td colspan="8">Categorize the different Fluids in Kinematics and Dynamics.</td></tr>
<tr><td>CO 3</td><td colspan="8">Determine the major and minor losses in pipes.</td></tr>
<tr><td>CO 4</td><td colspan="8">Examine Boundary Layer Separation in Fluid Flows.</td></tr>
<tr><td>CO 5</td><td colspan="8">Compare different Hydro dynamic forces of Jet and determine the various Turbines.</td></tr>
</table>

UNIT- I

Fluid Statics: Dimensions and units: fluid properties, mass density, weight density, specific gravity, viscosity, vapor pressure and their influence on fluid motion- atmospheric pressure, gauge pressure and vacuum pressure –measurement of pressure- Piezometer, U-tube and differential manometers.

UNIT-II

Fluid Kinematics: classification of flows-steady & unsteady, uniform, non-uniform, laminar, turbulent, rotational, and irrotational flows-equation of continuity for one dimensional flow. Fluid dynamics: -Bernoulli's equation for flow along a stream line, momentum equation and its application on force on pipe bend.

UNIT-III

Closed conduit flow: Laminar and turbulent flow through pipes: Reynolds experiment significance of Reynolds's number, Darcy Weisbach equation, chezy‟s formula, friction factor - Minor losses in pipes- pipes in series and pipes in parallel- Measurement of flow: Pitot tube(Derivation Only).

UNIT-IV

Boundary Layer Flow: Introduction, Definitions, Drag force on a flat plate due to Boundary layer, Analysis of Turbulent Boundary layer, Separation of Boundary layer.

UNIT-V

Basics of Hydraulic Machinery: Hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency.

Hydraulic Turbines: Classification of turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design –draft tube theory- Unit and specific quantities, Hydraulic Pumps: Working principle of Centrifugal and Reciprocating pump. (No-derivations and No Problems).

Text Books:

1. Fluid Mechanics and Machinery by Jagadeesh lal.
2. Fluid Mechanics and Hydraulic Machinery MODI and SETH, S.Chand & co, New Delhi
3. Fluid Mechanics and Hydraulic Machines By S. C. Gupta.

Reference Books:

1. Fluid Mechanics and Fluid Power Engineering by D.S. Kumar, Kotaria & Sons.
2. 3. Hydraulic Machines by Banga & Sharma, Khanna Publishers.
3. Fluid Mechanics and Hydraulic Machines by R. K. Rajput, Lakshmi Publications.

WEBSITES:

1) https://nptel.ac.in/courses/112/105/112105269/
2) https://nptel.ac.in/courses/112/105/112105171/
3) https://nptel.ac.in/courses/112/105/112105206/
4) https://nptel.ac.in/courses/112/105/112105183/
5) https://nptel.ac.in/courses/112/106/112106200/

<table>
<tr><th>Course Title</th><th colspan="4">Manufacturing Process</th><th colspan="3">B.Tech ME III Sem (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">2003303</td><td rowspan="2">PC</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The students completing this course are expected:

- The primary objective of this course is to introduce the concept of manufacturing technology with the help of various processes widely employed in industries.
- The course consists of casting, welding, sheet metal forming, extrusion and forging processes with the related details of equipment and applications.
- To understand various metal working process. To appreciate the capabilities, advantages and the limitations of the processes.
- To understand the various concepts of metal forming and forging along with their applications.

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

CO 1	Interpret foundry practices like pattern making, mold making and Core making.
CO 2	Illustrate special casting processes, their Advantages, Limitations and Applications.
CO 3	Demonstrate the various types of joining processes and select the appropriate one according to the application.
CO 4	Explain and relate the basics of hot and cold working process, their advantages, Limitations and Applications.
CO 5	Illustrate basic principles of Sheet metal operations.

UNIT-I

METAL CASTING PROCESSES: Introduction, Steps involved in making a casting, casting terms, Pattern making - types of patterns, pattern materials, and pattern allowances. Mould making - type of moulding sands, moulding sand properties, methods of sand testing, moulding machines – types of moulding machines. Core making - Core sands, Types of cores, Core prints, Chaplets, Chills, Risers and Gating systems used in casting.

UNIT-II

SPECIAL CASTING PROCESSES: Shell Moulding, Precision Investment Casting, Permanent Moulding Casting, Die Casting, Vacuum Die Casting, Low Pressure Die Casting, Centrifugal Casting, Continuous Casting, Squeeze Casting. Melting of metals in casting-Cupola furnace, Casting Cleaning Casting Defects - Causes and Remedies.

UNIT-II

WELDING PROCESSES: Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, Manual metal arc welding, submerged arc welding, and Inert Gas welding- TIG & MIG welding. Resistance welding, Solid state welding processes- Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma welding, Laser welding, electron beam welding, Soldering & Brazing. Welding Defects – Causes and Remedies.

UNIT-IV

METAL FORMING PROCESSES: Plastic deformation in metals and alloys, Hot working and Cold working, Strain hardening and Annealing.

Bulk forming processes: Forging - Types Forging, Smith forging, Drop Forging, Roll forging, Forging hammers, Rotary forging, forging defects; Rolling – fundamentals, types of rolling mills. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

UNIT-V

SHEET METAL FORMING: Shearing operations- Punching, Blanking and piercing- Bending and forming- Drawing and its types- wire drawing and tube drawing- coining- Hot and cold spinning- Types of presses and press tools.

Text Books:

1) P N. Rao, "Manufacturing Technology", Vol-I, 4th Edition, Tata McGraw-Hill Publishing Limited,
2) P. Ghosh, A., and Malik, A. K., "Manufacturing Science, Affiliated East west Press Pvt. Ltd.2010
3) S. Kalpakjian, Manufacturing Processes for Engineering Materials, Fifth edition. Pearson Education, 2009

Reference Books:

1) P.C. Sharma, "A text book of production technology", S. Chand and Company, 2014
2) Begman, „Manufacturing Process", John Wilely & Sons,2011
3) Production Technology by K.L. Narayana, J.K. International Publications.3rd Edition,2014
4) Rajput R.K, "A text book of Manufacturing Technology‟, Lakshmi Publications, 2015
5) Hajra Choudhury, "Elements of Workshop Technology, Vol. I and II", Media Promoters Pvt. Ltd.Mumbai, 2020
6) Production Technology by R.K Jain, 6th edition, 2020.

<table>
<tr><th>Course Title</th><th colspan="4">Engineering Thermodynamics</th><th colspan="3">B.Tech ME III Sem (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">2003304</td><td rowspan="2">PC</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>
</table>

Course Objectives:

. The students completing this course are expected:

- Concepts of heat, work, energy and governing rules for conversion of one form to other.
- Applications of I & II law of thermodynamics.
- To understand concept of entropy for identifying the disorder and feasibility of a thermodynamic process.
- To familiarize steam properties to understand working of steam power plants.
- To familiarize psychometric properties to understand working of Refrigeration and Air conditioning systems.

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

CO 1	Describe the thermodynamic system, control volume, thermodynamic properties, thermodynamic equilibrium and energy transfer in the form of heat and work in various applications.
CO 2	Analyze how energy transformation occurs from one form to another in open and closed systems and able to apply Steady Flow Energy Equation to various engineering devices.
CO 3	Identify the major difference in the working of a heat engine, heat pump and a refrigerator and execute the calculations of their efficiencies.
CO 4	Evaluate entropy changes in wide range of processes and determine the reversability and irreversability of a process from such calculations.
CO 5	Judge the properties of pure substances and familiarize with psychometric properties to understand the working of refrigeration and air conditioning systems.

UNIT-I

Basic Concepts and Definitions: Classical and statistical thermodynamics, definitions of thermodynamic terms, quasi – static process, point and path functions, forms of energy, ideal gas and real gas, Zeroth law of thermodynamics.

Work and Heat: Non flow (P.dV) or displacement work in various reversible processes, Heat Transfer, comparison of work and heat.

UNIT-II

First Law of Thermodynamics: First law for a closed system undergoing a cycle and for a process, Joules experiment, PMM-I.

First Law Applied to Non-Flow and Flow Process, Corollaries and limitations of First Law of Thermodynamics. Simple problems.

UNIT-III

Second Law of Thermodynamics: Kelvin-Plank statement, Clausius statement, equivalence of Kelvin-plank and clausius statements, Heat engine, heat pump and refrigerator, reversibility and irreversibility, Carnot Cycle, Carnot's Theorem, PMM-II - simple problems.

UNIT-IV

Entropy: Clausius theorem, Definition of entropy, principle of entropy increase, T-s plot, change in entropy in various reversible processes.

Availability & Irreversibility: Definition of; exergy and energy, Availability in steady flow, non-flow processes and irreversibility.

UNIT-V

Properties of Steam : Formation of steam form ice to super-heated steam with reference to T-V, P-V & T-S diagrams, properties of steam, Quality of steam, expressions for the change in internal energy, enthalpy, work, heat, entropy in various processes, Use of steam Tables and Mollier's chart. Simple problems.

Psychometry

Definitions of - Dry Bulb temperature, Wet-Bulb Temperatures, Specific humidity (or) Humidity Ratio, Dew Point Temperature, Degree of Saturation, Relative Humidity, Sensible Heating, Sensible cooling, Humidification and Dehumidification. Measurement of psychometric properties using psychometric chart. Simple Problems.

Text Books:

1) P.K. Nag Engineering Thermodynamics, 6th Edition 2019 Tata McGraw Hill, New Delhi.
2) Cengel, Thermodynamics – An Engineering Approach, 6th Edition 2019 Tata McGraw Hill, New Delhi.
3) V. Babu, Fundamentals of Engineering Thermodynamics, 2019

Reference Books:

1) B.P Mistra, Engineering Thermodynamics. .
2) Thermodynamics – Yadav" Central Publishers
3) E. Ratha Krishna, Fundamentals of Engineering Thermodynamics, PHI Publishers, New Delhi.

<table>
<tr><td>Course Title</td><td colspan="5">Mechanics of Materials</td><td colspan="3">B.Tech ME III 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">2003305</td><td rowspan="2">ES</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The students completing this course are expected:

- To impart basic principles of solid mechanics and their associated laws.
- To understand the behaviour of engineering materials for different types of loads
- To understand the behaviour of beams under different types of loads
- To understand the nature of stresses developed in material under complex loading system
- To analyse the cylindrical shells under circumferential and radial loading conditions

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

CO 1	Determine the deformations, stresses and strains in members subjected to the axial and thermal load.
CO 2	Evaluate and explain the variations of the shear forces and bending moments along the axis of the beam.
CO 3	Use the bending stress concept to design the machine and tructural components.
CO 4	Evaluate the deflections at various points in the beam and determine the critical buckling loads of columns under different boundary conditions..
CO 5	Analyse the principal stresses/strains and visualize the variations of normal and shear stresses in components.

UNIT- I

SIMPLE STRESSES & STRAINS: Rigid and Deformable bodies – Strength, Stiffness and Stability – Stresses; Tensile, Compressive and Shear – Deformation of simple and compound bars under axial load – Thermal stress – Elastic constants – Strain energy and unit strain energy – Strain energy in uniaxial loads.

UNIT –II

SHEAR FORCE AND BENDING MOMENT: Types of beams: Supports and Loads – Shear force and Bending Moment in beams – Cantilever, Simply supported and Overhanging beams subjected to point loads, UDL, Uniformly varying loads and combination of these loads- Point of Contra flexure- Relation between S.F, B.M and rate of loading at a section of a beam.

UNIT –III

FLEXURAL STRESSES: Theory of simple bending- Assumptions- Derivation of bending equation (M/I = f/y = E/R) – Neutral axis- Determination of Bending stresses- section modulus of rectangular and circular sections (Solid and Hollow), I, T, Angle and Channel sections.

UNIT- IV

BEAM DEFLECTION: Elastic curve of Neutral axis of the beam under normal loads – Evaluation of beam deflection and slope: Double integration method, Macaulay Method.

Columns: End conditions – Equivalent length of a column – Euler's equation – Slenderness ratio – Rankin's formula for columns.

UNIT- V

PRINCIPAL STRESSES & STRAINS: Principal stresses and Principal planes, Method of determining stresses on oblique sections, Mohr's circle.

CYLINDERICAL SHELLS: Thin cylindrical shells – Derivation of formula for longitudinal and circumferential stresses –hoop, longitudinal stresses and volumetric strains.

Text Books:

1. Mechanics of solids by Timo shenko,TMH Publications.
2. Russell Hibbeler ,Mechanics of Materials, 2016.
3. James M. Gere, Barry J. Goodno, Mechanics of materials, 7th edition, Cengage learning, 2009.

Reference Books:

1. Nash W.A, Theory and problems in Strength of Materials, Schaum Outline Series, McGraw-Hill Book Co,
2. Strength of materials by Bhavikatti, Lakshmi Publications.
3. Engineering Mechanics of Solids by Popov E.P, Prentice-Hall of India, New Delhi.
4. Singh D.K "Mechanics of Solids" Pearson Education.
5. Beer F. P. and Johnston R, Mechanics of Materials, McGraw-Hill Book Co, Third Edition.

<table>
<tr><td>Course Title</td><td colspan="4">Fluid Mechanics & Hydraulic Machinery Lab</td><td colspan="4">B.Tech ME III 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">2003306</td><td rowspan="2">ES</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:
The students completing this course are expected:
This course “Fluid Mechanics and Hydraulic Machines” lab imparts intensive and extensive practical knowledge of the lab so that students can understand the importance of concepts of “Fluid Mechanics and Hydraulic Machines” in the field of engineering. The student should able to develop theoretical / practical capabilities so that they can characterize, transform, use and apply in engineering from the knowledge gained in solving related engineering problem.

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

CO 1	Enable the students to use knowledge of Fluid mechanics and hydraulic machines for practical applications.
CO 2	Develop the ability for running hydraulic machines lab.
CO 3	Understand the working function of various devices used in hydraulic power plant.
CO 4	Examine the principle of Bernoulli’s theorem.
CO 5	Determine the forces for impact of jet on Vanes.

LIST OF EXPERIMENTS:

1. Verification of Bernoulli’s Equation
2. Calibration of mouth piece/orifice
3. Calibration of Triangular Notch/Rectangular Notch
4. Calibration of Venturi meter
5. Calibration of Orifice meter
6. Determination of Friction Factor for a given pipe line
7. Impact of Jet on Vanes
8. Performance Test on Pelton Wheel
9. Performance Test on Francis Turbine
10. Performance Test on Kaplan Turbine
11. Performance Test on Single Stage Centrifugal Pump
12. Performance Test on Reciprocating Pump

Note: Conduct Any Ten FROM ABOVE Experiments

<table>
<tr><th>Course Title</th><th colspan="4">Manufacturing Technology Lab</th><th colspan="4">B.Tech ME III Sem (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">2003307</td><td rowspan="2">PC</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The students completing this course are expected:

- The student should understand the some fundamental aspects and design concepts of manufacturing, pattern and pattern makings for the casting process.
- To determine the sand Viz., strengths and permeability of a sand materials and moisture percentages of green sand.
- To teach techniques adopted in welding processes like arc, gas, spot, plasma and brazing processes and also deep drawing process for making a small size parts with the help of blanking, piercing operations.
- To extrusion operations, bending and processing of plastics like injection moulding and blow moulding.
- The student should be prepared to continue the study and analysis of the production machine parts.

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

CO 1	Develop models like pattern , mold making and Core making
CO 2	Illustrate special casting processes and their applications.
CO 3	Demonstrate the various types of joining processes.
CO 4	Develop models using Hydraulic press.

I. METAL CASTING LAB:

1) Pattern Design and Making : 1 Exercise - for one casting
2) Sand Properties Testing : 2 Exercises - Strength and Permeability
3) Casting : 1 Exercise

II. WELDING LAB:

1) Arc Welding : 3 Exercises (Lap joint, Butt Joint & T-Joint)
2) Spot welding : 1 Exercises
3) Soldering of thin sheets : 1 Exercises

III. MECHANICAL PRESS WORKING:

1) Hydraulic Press: Deep Drawing : 1 Exercise
2) Pipe Bending : 1 Exercise

IV. PROCESSING OF PLASTICS:

1) Injection Moulding : 1 Exercise
2) Blow Moulding : 1 Exercise

<table>
<tr><td>Course Title</td><td colspan="4">Mechanics of Materials Lab</td><td colspan="3">B.Tech ME III 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">2003308</td><td rowspan="2">ES</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The students completing this course are expected:

- The student should understand the some fundamental aspects and design concepts of To develop capability to of mount the specimen on the matrix material and able to identify the given metal by observing the micro structure
- To Distinguish the Ferrous and non-Ferrous structures
- To study the effect of heat treatment on microstructures
- To understand the some fundamental aspects and failure modes of engineering materials with the applications of sudden and gradually applied loads.
- To find out the hardness of the various materials with the help of Brinell‟s & Rockwell hardness testing machines.

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

CO 1	Gains the knowledge of preparing the sample for metallurgical observations.
CO 2	Identify the material based on its micro structure and also assess its mechanical properties.
CO 3	Realize the effect of heat treatment on the mechanical properties of the material.
CO 4	Determine the Elastic constants and strength of the given material using Tension compression, torsion & Deflection tests.
CO 5	Determine the strain energy stored in the material under impact loads.

LIST OF EXPERIMENTS:

Note: Conduct any FIVE experiments form each cycle.

Cycle-I: Materials Science Lab

1. Specimen preparation and study of the Microstructure of Low carbon steel, Medium carbon steels and high carbon steels.
2. Study of the Micro Structures of Cast Irons.
3. Study of Micro Structure of Austenitic- stainless steel and High speed steel.
4. Study of the Micro Structures of Non-Ferrous alloys (Al-alloy, Cu-alloy)
5. Determination of hardenability of steels by Jominy End Quench Test.
6. Magna Flux testing method.

Cycle-II: Mechanics of Solids Lab

1. Determination of stress-strain characteristics of Mild steel rod using Universal Testing Machine.
2. Torsion test on mild steel rod.
3. Determination of Impact strength of the metals.
4. Hardness test on metals – using Brinnel & Rockwell hardness testing machine.
5. Determination of modulus of Elasticity and flexural rigidity of beams.
6. Determination of modulus of rigidity of helical springs.

<table>
<tr><td>Course Title</td><td colspan="3">CATIA
(Skill Oriented Course)</td><td colspan="4">B.Tech ME III 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">2003309</td><td rowspan="2">PC</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>0</td><td>0</td><td>2</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
To establish the scientific and regulatory basis of graphical representation in the general context of Industrial Engineering, as a means of expression and communication for the design, creation, definition and development of an industrial installation and/or product making practical use of the current technological means available, consistent with the scientific teaching framework and in response to technological evolution.</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 user interface of CATIA software.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the different commands to design the complicated machine parts.</td></tr>
<tr><td>CO 3</td><td colspan="8">Create a assembly of of machine components</td></tr>
<tr><td>CO 4</td><td colspan="8">Examine the assembly of Machine commands.</td></tr>
</table>

Syllabus:

1. INTRODUCTION TO STANDARDISATION: Formats. Scales. Lines. Lettering.

2. ANALYSIS OF CORPOREAL FORMS. Formal definition. Constructive geometry. Main, basic, complementary andauxiliary views. Internal and external visualisation.

3. DIMENSIONING. Defining dimensions. Definition of functional, manufacturing, verification and geometricdimensions.

4. DIMENSIONAL AND GEOMETRIC TOLERANCES. Definition of dimensional and geometric error.Standardised adjustments. Form, position and runout tolerances.

5. MECHANICAL SURFACE STATE. MATERIALS. TREATMENTS. Roughness types.

6. HOLDING SYSTEMS. Disassemble and non-disassemble.

7. MOTION TRANSMISSION AND TRANSFORMATION ELEMENTS. Cogs. Friction and chain wheels. Belts andpulleys. Springs. Bearings. Cams and eccentric cams.

8. MECHANICAL ASSEMBLIES. Areas of Mechanical Engineering, Electrical Engineering, and Industrial ChemicalEngineering.

Assembly and exploded view drawings. Symbols.

9. INTRODUCTION TO COMPUTER AIDED DESIGN. CAD/CAM/CAE/CIM
10. INTRODUCTION TO A CAD SYSTEM: CATIA. Catia V5 environment.
 SOLID 3D MODELLING. OBTAINING 2D DRAWINGS. ASSEMBLY OF MECHANICAL ASSEMBLIES. CADPRACTICE. Catia V5 Sketcher, Part, Generative Drafting, Product and Assembly Modules

Reference Books:

1. Apuntes de Teoría y Prácticas de Expresión Gráfica. Profesores del Departamento de Expresión Gráfica. EscuelaUniversitaria de Ingeniería de Vitoria-Gasteiz. 2010
2. FELEZ, Jesús; MARTINEZ M. Luisa. Ingeniería Gráfica y diseño. Madrid. 1st Edition. (Editorial
3. Síntesis 2008). 867 pages. ISBN 978-84-975649-9-1
4. Normas UNE de Dibujo Técnico (3rd edition) Cd-rom. AENOR. 2005.
5. Notes on 3D Modelling and CAD Practice. Teachers of the Department of Graphic Expression. University Collegeof Engineering of Vitoria-Gasteiz. 2010
6. DASSAULT SISTEMES Users Guide Part Design / Wireframe and surfaces / / Assembly design / Generativedrafting /CATIA V5 2008

Websites

- www.aenor.es ,
- www.iso.org
- www.abgam.es

<table>
<tr><td>Course Title</td><td colspan="5">Environmental Science
(CE, ME,EEE-III SEM)</td><td colspan="3">B.Tech ME III 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">20993M1</td><td rowspan="2">PC</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>-</td><td>0</td><td>0</td><td>40</td><td>60</td><td>30</td></tr>
<tr><td colspan="5">Mid Exam Duration: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To make the students to get awareness on importance of environment in our life.
• To understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life 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 the Energy flow, bio-geo chemical 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

Introduction to Environmental Studies- Natural Resources

Multidisciplinary nature of environmental studies. Scope and Importance.

Natural resources and associated problems – Renewable and non renewable Resources.

(a) Forest resources –Deforestation: Causes and impacts due to mining, dams – benefits and problems

(b) Water resources – Use and over utilization of surface and ground water – Floods, drought, andconflicts over water.

(c) Energy resources –Renewable and Non Renewable energy resources, use of alternate energyresource.

(d) Land resources -Soil erosion and desertification, Land degradation.Role of an individual in conservation of natural resources.

Learning Outcomes: At the end of this unit, student will be able to

- understand the multidisciplinary nature of the environment
- understand the importance of natural resources
- analyze the problems associated with excess usages of natural resources
- understand role of individual in protection of environment

UNIT- II

ECOSYSTEMS

Ecosystem- Definition–Structure and function of an ecosystem– Energy flow in the ecosystem –Foodchains, food webs, Ecological succession.

Introduction, types, characteristic features of the following ecosystem:

(a) Forest ecosystem (b) Grassland ecosystem

(c) Desert ecosystem (d) Aquatic ecosystems (ponds,streams, lakes, rivers, oceans, estuaries)

Learning Outcomes: At the end of this unit, student will be able to

- articulate the basic structure and functions of ecosystem
- provides knowledge on interrelationship of one organism with other organism
- get awareness on different types of ecosystems present in our surroundings and their importance.

UNIT-III

BIODIVERSITY AND ITS CONSERVATION

Levels of Biodiversity: genetic, species and ecosystem diversity – Bio-geographical classification of India – Hotspots .Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – India as a mega-diversity nation – Endangered and endemic species. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Learning Outcomes: At the end of this unit, student will be able to

- explains the concept of genetic diversity
- explain endangered and endemic species of India.
- identify the threats to biodiversity due to human involvement
- Provides knowledge on conservation of biodiversity.

UNIT IV

ENVIRONMENTAL POLLUTION

Definition, Cause, effects and control measures of (a) Air Pollution,(b)Water pollution,(c)Soil pollution (d)Noise pollution. Nuclear hazards –Risks to human health .Solid waste management: Control measuresof urban and industrial wastes. Pollution case studies.Global Warming, Ozone layer depletion, acid rainsand impacts on human communities and environment.Disaster management: floods, earthquakes, cyclones

Learning Outcomes: At the end of this unit student will be able to

- understand Cause, effects and control measures of air pollution.
- understand soil, noise & water pollution.
- get awareness on impact of global warming and acid rains on humans and environment.
- get knowledge on management of solid waste.
- explain disaster management cycle in India.

UNIT -V

Environmental policies

Environment Protection Act – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act .International agreements: Montreal and Kyoto protocols and conservation on Biological Diversity (CBD).

Human communities and Environment

Human population and growth: impacts on environment, human health and welfares.
Environmental movements: Chipko, silent valley.
Environmental Ethics: Role of individual in environmental conservation. Public awareness.

Learning Outcomes: At the end of this unit student will be able to

- explain the enforcement of Environmental legislation
- get awareness on punishments associated with destruction of environment
- Understand the impact of growing population on welfare of society
- Get knowledge on how to increase public awareness on protection of environment.

FIELD WORK: Visit to a local area to document environmental assets River / forest grass land /hill/mountain – Visit to a local polluted site-Urban/Rural/Industrial/Agricultural Study of common plants, insects, birds – Study of simple ecosystems-pond, river, hill slopes, etc..

Text Books:

1. Text book of Environmental Studies for Undergraduate Courses by ErachBharucha for UniversityGrants Commission, Universities Press.
2. Environmental studies by Benny Joseph, Mc, Graw Hill Publications.
3. Principles and a basic course of Environmental science for under graduate course byKousic,KouShic.
4. Text book of Environmental science and Technology by M. AnjiReddy,BS Publication.

Reference Books:

1. Environmental sciences and engineering – J. Glynn Henry and Gary W. Heinke – Printice hall ofIndia Private limited.
2. Environmental Studies by AninditaBasak – Pearson education.
3. Introduction to Environmental engineering and science by Gilbert M. Masters and Wendell P.Ela - Printice hall of India Private limited.

B.Tech IV SEM ME (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Numerical Methods and Probability</td><td colspan="3">B.Tech ME IV 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">2021401</td><td rowspan="2">BS</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
The students completing this course are expected:
To familiarize the students with the foundations of probability and Numerical methods.
To impart probability concepts and Numerical methods in various applications in Engineering</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 Numerical methods to solve transcendental equations and rate of convergence. Analyze the concept of Interpolation its applications in digital image processing, computer graphics and in many engineering disciplines</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand the concept of Numerical differentiation and integration and its importance in mechanics.</td></tr>
<tr><td>CO 3</td><td colspan="8">Identify various numerical methods to solve linear and non-linear ordinary differential equations and its applications in non-linear analysis.</td></tr>
<tr><td>CO 4</td><td colspan="8">To know the importance of probability, random variables and distributions in solving various mechanical and civil engineering problems.</td></tr>
<tr><td>CO 5</td><td colspan="8">To know Random variables, Expectation, Discrete and continuous.</td></tr>
</table>

UNIT-I

Solution of Algebraic and Transcendental Equations: Introduction – The Bisection Method – The Method of False Position – The Iteration Method – Newton-Raphson Method.

UNIT-II

Interpolation: Introduction – Finite differences – Forward Differences – backward Differences –Newton's forward and backward difference formulae for interpolation – Gauss forward and backward difference formulae for interpolation - Lagrange's Interpolation formula.

UNIT-III

Numerical Differentiation – Numerical Integration – Newton-cote's integration formula – Trapezoidal rule – Simpson's 1/3 Rule – Simpson's 3/8 Rule.

Numerical solution of Ordinary Differential equations: Solution by Taylor's series-Picard's Method of successive Approximations – Euler's Method – Runge – Kutta Method.

UNIT-IV

Curve fitting: Fitting a straight line – Second degree curve – Exponential curve-Power curve by method of least squares.

UNIT-V

Basic concept of probability – Random variables – Expectation – Discrete and continuous distributions.

Text Books:

1) Iyengar T.K.V., Krishna Gandhi B., Rangantham S., and Prasad M.V.S.S.N., (2006), “Mathematical Methods”, S. Chand & Company, India.
2) Iyengar T.K.V., Krishna Gandhi B., Rangantham S., and Prasad M.V.S.S.N., (2015), “Probability and Statistics”, S. Chand & Company, India.

Reference Books:

1) Erwin kreyszig., (2011), “Advanced Engineering Mathematics”, 10th Edition, John Wiley & Sons, United States
2) Ramana B.V., (2010), “Higher Engineering Mathematics”, Tata McGraw Hill New Delhi, 11th Reprint, India
3) Kandasamy P., Thilagavathy K., and Gunavathi K., (2012), 2nd Edition, Numerical Methods, S. Chand & Company, Reprint India
4) Sastry S.S., (2005), 4th Edition, “Introductory methods of numerical analysis”., PHI.
5) Grewal B.S., (2010), 35th Edition, “Higher Engineering Mathematics”., Khanna Publishers, India

<table>
<tr><td>Course Title</td><td colspan="5">Applied Thermodynamics</td><td colspan="3">B.Tech ME IV 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">2003402</td><td rowspan="2">PC</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>
</table>

Course Objectives:

. The students completing this course are expected:

- To learn about IC engines and , theory of combustion
- To learn about vapour cycles and their first law and second law efficiencies
- To learn about gas dynamics of steam through nozzles
- To learn the about reciprocating compressors with and without inter cooling.

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

CO 1	Analyze the air standard cycles and can explain the working principle of different IC engines.
CO 2	Explain various stages of combustion in SI and CI engines.
CO 3	Evaluate the performance of IC engines and can explain the various engine emissions and their BS norms.
CO 4	Analyze Vapour power cycles and combined gas & vapour power cycles.
CO 5	Understand the functionality and working principle of Reciprocating & Rotary compressors, vapour Compression & Vapour Absorption Refrigeration Systems.

UNIT-I

Air Standard Cycles: Air Standard Otto Cycle, Diesel Cycle, Thermal Efficiency, Comparison of Otto and Diesel. Simple problems on Otto & diesel cycles.

Introduction to IC Engines: Energy conversion, Classification of I.C. Engines, Working principle of two stroke and four stroke engines & application of I.C Engines.

UNIT-II

Combustion in I.C Engines: Stages of combustion in SI & CI Engines - Importance of flame speed and factors influencing the flame speed in SI engines- Importance of ignition delay period and factors affecting the ignition delay period in CI Engines- Abnormal Combustion - pre-ignition- Phenomenon of Knocking SI & CI, Summary of Engine variables affecting the knocking, Comparison of knock in SI & CI Engines.

UNIT-III

Testing and Performance: Engine Performance Parameters - Emissions from Diesel & Petrol Engines, BS-Norms - Simple problems on performance and heat balance sheet.

UNIT-IV

Vapor power cycles: Rankine cycle with superheating, reheating and regeneration. Supercritical and ultra super-critical Rankine cycle. Combined gas and vapor power cycles. Simple problems on Rankine Cycle.

UNIT-V

Steam Nozzles: Introduction - types, Steam flow through nozzles- condition for maximum discharge (critical pressure ratio), Nozzle efficiency - Simple problems.

Air Compressors: Introduction, Classification **-** Reciprocating compressors, optimal pressure ratio, effect of inter cooling, minimum work for multistage reciprocating compressors- Introduction to rotary compressors.

Refrigeration & Air Conditioning: Working principle of vapor compression & Vapor Absorption refrigeration system, – summer and winter air conditioning system.

Text Books:

1) Fundamentals of Thermodynamics, Sonntag, R. E, Borgnakke, C. and Van Wylen.
2) Thermodynamics and Heat Engines, R.Yadav, Central Book Depot.
3) Yunus A Cengel; Michael A Boles , Thermodynamics: An Engineering Approach, 2017.

Reference Books:

1) Thermal Engineering - M.L.Mathur & Mehta, Jain bros.
2) Thermal Engineering, R.K. Rajput, 7/e, Lakshmi Publications, 2009.
3) Fundamentals of Engineering Thermodynamics, Moran, M. J. and Shapiro

<table>
<tr><th>Course Title</th><th colspan="4">Kinematics of Machines</th><th colspan="3">B.Tech ME IV Sem (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">2003403</td><td rowspan="2">PC</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The students completing this course are expected:

To study about terms used in kinematics of machinery.

- To learn how to analyze the motions of link mechanisms and to analyze forces in machines.
- To analyze the motions of Cam and follower assembly.
- To locate the instantaneous centre for the given planer mechanism.
- To determine the velocity and accelerations of the linkages in a planer mechanism.
- To study about the toothed gears and related terminology.

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

CO 1	Classify different types of links and mechanisms used for different purposes in different machines.
CO 2	Solve the forces, velocities and accelerations in different mechanisms and machines components
CO 3	Determine the angular velocities by Instantaneous center method and discover straight-line motion Mechanisms
CO 4	Construct and analyze cam profiles for a specified motion of the follower
CO 5	Solve problems on toothed gears, cycloidal and involute profiles.

UNIT – I

MECHANISMS : Elements or Links – Classification – Rigid Link, flexible and fluid link – Types of kinematic pairs – sliding, turning, rolling, screw and spherical pairs – lower and higher pairs – closed and open pairs – constrained motion – completely, partially or successfully constrained and incompletely constrained .

MACHINES : Mechanism and machines – classification of machines – kinematic chain – inversion of mechanism – inversions of quadric cycle, chain – single and double slider crank chains.

UNIT - II

KINEMATICS: Velocity and acceleration – Motion of link in machine – Determination of Velocity and acceleration diagrams – Graphical method – Application of relative velocity method four bar chain.

Analysis of Mechanisms: Analysis of slider crank chain for displacement, velocity and acceleration of slider – Acceleration diagram for a given mechanism, Klein’s construction.

UNIT-III

PLANE MOTION OF BODY: Instantaneous center of rotation, centroids and axodes – relative motion between two bodies – Three centres in line theorem – Graphical determination of instantaneous centre, diagrams for simple mechanisms and determination of angular velocity of points and links.

Straight Line Motion Mechanisms: Exact and approximate copiers and generated types – Peaucellier, Hart and Scott-Rassul – Grasshopper – Watt T. Chebi-cheff and Robert Mechanisms and straight line motion, Pantograph.

UNIT – IV

CAMS: Definitions of cam and followers – their uses – Types of followers and cams – Terminology –Types of follower motion - Uniform velocity – Simple harmonic motion and uniform acceleration. Maximum velocity and maximum acceleration during outward and return strokes in the above three cases.

UNIT – V

TOOTHED GEARING: Higher pairs, friction wheels and toothed gears – types – law of gearing, condition for constant velocity ratio for transmission of motion, Form of teeth: cycloidal and involute profiles. Velocity of sliding – phenomena of interferences – Methods of interference. Condition for minimum number of teeth to avoid interference, expressions for arc of contact and path of contact.

Text Books:

1. Theory of Machines and Mechanisms-S.S.Rattan, Tata McGraw Hill Publishers
2. Theory of Machines by Thomas Bevan/ CBS.
3. Theory of Machines, 5th Edition, Dattaji K Shinde.

Reference Books:

1. Theory of Machines / R.K Bansal, Lakshmi Publications.
2. Theory of machines by Jagadishlal.
3. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age
4. The theory of Machines /Shiegley/ Oxford. Theory of machines – PL. Balaney/khanna publishers

<table>
<tr><td>Course Title</td><td colspan="5">Machine Tools</td><td colspan="3">B.Tech ME IV 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">2003404</td><td rowspan="2">PC</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="5">Mid Exam Duration: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objective:

- The objectives of this course are to introduce to demonstrate the fundamentals of machining processes and machine tools.
- To develop knowledge and importance of metal cutting parameters, tool materials, cutting fluids and tool wear mechanisms.
- To apply knowledge of basic mathematics to calculate the machining parameters for different machining processes and acquire knowledge on advanced manufacturing processes.
- The students will have the knowledge and hands-on experience that will enable them to work in a typical machine shop.

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

CO 1	Apply basic knowledge in machining aspects of orthogonal cutting, oblique cutting, mechanism of chip formation and use of engine lathe.
CO 2	Examine the working principle and parts of shaper, planer, slotter and unconventional machining methods.
CO 3	Analyze the basic parts and operations performed on drilling and boring machines.
CO 4	Evaluate the use of milling machines and applications of indexing methods on milling
CO 5	Select the abrasives for grinding wheels, lapping , honing and broaching operations.

UNIT – I

Basic elements of machining – Orthogonal, Oblique Cutting, Classification of cutting tools. Geometry of Single point cutting tool and Angles, Types of Chips, Chip Breakers. Cutting Tool materials, Tool failures.

ENGINE LATHE: Principle of working, Specification of Lathe, Types of Lathes, Operations performed, Workholding devices, Machining Parameters – Cutting Speed, Feed, Depth of Cut and Machining time, Taper turning methods, Thread cutting.

UNIT – II

Shaper– Working principle, Specifications, Classification, Principle parts of a Shaper, Machining time Calculations.

Planer - Working principle, Specifications, Classification, Principle parts of a Planer

Slotter - Working principle, Specifications, Classification, Principle parts of a Slotter

Un conventional Machining methods:EDM,ECM,EBM.

UNIT – III

DRILLING MACHINES: - Specifications, Operations performed, tool holding devices, Twist drill, types of drilling machines – Sensitive drilling machine, Upright drilling machine, radial drilling machine, Gang drilling machine, Multiple Spindle drilling machine.

BORING MACHINES: Types – Horizontal Boring machine, Jig Boring machine.

UNIT – IV

Milling machine – Principles of working – specifications – classifications of milling machines – Principle features of horizontal, vertical and universal milling machines – machining operations,– Up milling and Down milling - Working mechanism of Universal Dividing head, methods of indexing –Direct, Plain, Compound, Differential and Angular.

UNIT –V

GRINDING MACHINES: Classification of grinding machines – Cylindrical and Surface grinding machines – Tool and Cutter Grinders. Grinding wheel – Specification, Selection of grinding wheel, Wheel truing and Wheel dressing.

BROACHING : Types of broaching machines – Horizontal, Vertical, Continuous broaching machines, Elements of broach, broaching operations.Introduction to Lapping and Honing.

Text Books:

1. Winston A. Knight , Geoffrey Boothroyd, Fundamentals of Metal Machining and Machine Tools, 2005
2. Production Technology, R.K. Jain and S.C. Gupta.
3. Workshop Technology – Vol II, B.S. Raghuwanshi.

Reference Books :

1. Machine Tools, C.Elanhezhian and M. Vijayan, Anuradha Agencies Publishers.
2. Manufacturing Technology, Kalpakzian, Pearson
3. Production Technology, H.M.T. (Hindustan Machine Tools).
4. Introduction to Manufacturing Technology, Date, Jaico Publ. House

<table>
<tr><td>Course Title</td><td colspan="4">APPLIED THERMODYNAMICS LAB</td><td colspan="3">B.Tech ME IV 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">2003406</td><td rowspan="2">PC</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: 2Hrs</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The students completing this course are expected:

- Imparting intensive and extensive knowledge of the Lab so that students can understand the role of Thermal Engineering in the field of Engineering.
- Developing theoretical/practical capabilities of students so that they can characterize, transform and use Thermal Engineering in Engineering and Apply knowledge gained in solving related Engineering problems.
- The student should able to know the use of various air compressors.
- The student should able to know the use of refrigeration systems.
- The student should able to know the use of air conditioning systems.

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

CO 1	Applying the practical skills in designing and testing the thermal engineering related equipment.
CO 2	How to estimate the performance of a boiler.
CO 3	How to estimate the performance of an air compressor.
CO 4	Conducting and Estimating the performance of a refrigerator and air conditioning systems.

LIST OF EXPERIMENTS:

(Conduct any Five from each cycle for Record)

<u>CYCLE: I</u>

1) Draw the Actual Valve & Port timing Timing Diagrams of a four stroke Diesel/ two stroke petrol Engines.
2) Performance Test on 4S Single Cylinder/Multi Cylinder Petrol / Diesel Engine test rigs.
3) Performance Test on VCR Computerized Multifuel Research Engine test rig.
4) Determination of Engine friction Power by Morse, retardation & Willan's line test Methods.
5) To draw the HBS/HBC on 4S Single Cylinder/Multi Cylinder Petrol / Diesel Engine test rigs.
6) To draw the HBS/HBC on VCR Computerized Multifuel Research Engine test rig.
7) Measurement of I.C Engine Exhaust Gas Emissions from Petrol/Diesel Engines.

CYCLE: II

1) Determination of Volumetric & Isothermal Efficiency of Multi Stage Reciprocating Air Compressor Test Rig.
2) Performance test on Centrifugal/axial flow air compressor test rig.
3) Determination of COP of a Vapor Compression Refrigeration Test Rig.
4) Determination of COP of a Summer/winter Air Conditioning Test Rig.
5) Determination of Calorific Value of a liquid/gaseous fuels.
6) Determination of Kinematic & Dynamic Viscosities of liquid fuels by using Redwood & Say Bolt Viscometer.
7) Determination of flash & Fire Points of Liquid Fuels by using Cleveland's & Ables apparatus.

STUDY:

1) Study of I.C Engine Parts.

II B.Tech, II-Sem (ME)

<table>
<tr><td>Course Title</td><td colspan="5">Manufacturing Technology Lab-II</td><td colspan="3">B.Tech ME IV 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">2003407</td><td rowspan="2">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>-</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration:</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objective:
The students are required to understand the parts of various machine tools and operate them. They are required to understand the different shapes of products that can be produced on these machine tools.</td></tr>
<tr><td colspan="9">Course outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO1</td><td colspan="8">Identify various machine tools used in machine shop</td></tr>
<tr><td>CO2</td><td colspan="8">Illustrate turning, taper turning, knurling &thread cutting on engine lathe</td></tr>
<tr><td>CO3</td><td colspan="8">Ability to use shaper, slotter, drilling & grinding machines</td></tr>
<tr><td>CO4</td><td colspan="8">Able to manufacture a gear on milling machine</td></tr>
</table>

List of Experiments

1.Demonstration of construction & operations of general purpose machines: Lathe, Drilling machine, Milling machine, Shaper, Planing machine, Slotting machine, Cylindrical Grinder, Surface grinder and Tool &cutter grinder.

2. Job on Step turning and taper turning on lathe machine
3. Job on Thread cutting and knurling on -lathe machine.
4. Job on Drilling and Tapping
5. Job on Shaping
6. Job on Slotting
7. Job on Milling (Gear cutting)
8. Job on Surface Grinding
9. Job on Grinding of Tool angles.

<table>
<tr><th>Course Title</th><th colspan="5">Computer Aided Machine Drawing</th><th colspan="3">B.Tech ME IV Sem (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">2003408</td><td rowspan="2">PC</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>0</td><td>-</td><td>3</td><td>1.5</td><td>40</td><td>60</td><td>100</td></tr>
<tr><td colspan="6">Mid Exam Duration:</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objective:

- Introduce conventional representations of material and machine components.
- Train to use software for 2D and 3D modeling.
- Familiarize with thread profiles, riveted, welded and key joints.
- Teach solid modeling of machine parts and their sections.

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

CO 1	Demonstrate the conventional representations of materials and machine components.
CO 2	Create solid models and sectional views of machine components.
CO 3	Design 3D assemblies into 2D drawings.
CO 4	Create manufacturing drawing with dimensional and geometric tolerances
CO 5	Create the part modeling and assembling with limits, fits and tolerances.

The following contents are to be done by any 2D software package

Conventional representation of materials and components:

UNIT-I

Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts, bolted joint, bolted joint with washer and locknut, stud joint, screw joint.

UNIT-II

Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted , double riveted double strap joints.

UNIT-III

Welded joints: Lap joint and T joint with fillet, butt joint with conventions.

Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key. Shaft coupling, bushed pin-type flange coupling, universal coupling, Oldhams' coupling.

The following contents to be done by any 3D software package

UNIT-IV

Sectional views

Creating solid models of complex machine parts and create sectional views.

UNIT-V

Assembly drawings: (Any four of the following using solid model software)

Lathe tool post, tool head of shaping machine, tail stock, machine vice, gate valve, carburettor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling,

production drawing:

Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare production drawing with dimensional and geometric tolerances.

Text Books:

1. K.L.Narayana, P.Kannaiah ,Machine Drawing ,New age international Publications, sixth Edition 2019
2. Dr.R.K Dahwan ,A Text Book of Machine Drawing ,s.chand Publications,2018
3. N.D.Bhatt ,Machine Drawing , charotar publications 2018

Reference Books:

1. Cecil Jensen, Jay Helsel and Donald D.Voisinet, Computer Aided Engineering Drawing, Tata Mcgraw-Hill, NY, 2016
2. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2016.
3. B.Bhattacharya, Machine Drawing, oxford publications 2017.

Course Title	CNC Programming and Simulation					B.Tech ME IV Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003409	**SC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		1	**0**	**2**	**2**	**40**	**60**	**100**
Mid Exam Duration:					**End Exam Duration:**			

Course Objectives:

- To study the basics of NC
- To study the CNC Part Programming Fundamentals
- To study the Turning center Programming
- To study various CNC Turning and simulations
- To study Various Milling and simulations

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

CO1	Identify the various Introductory concepts of Computer Numerical Control.
CO2	Develop Knowledge on CNC Codes and their appropriate usage in Coding.
CO3	Determine different Machining Centers and Turning centers, Motion commands, thread and canned cycles.
CO4	Create and simulate different CNC Turning Programs and operations.
CO5	Build and simulate different CNC Milling Programs and operations.

UNIT-I

Introduction to Computer Numerical Control, Introduction, Numerical Control, Numerical control Modes, Numerical control elements, NC Machine Tools. Cutting Tool Materials, Turning Tool Geometry, Milling Tooling systems, Tool Presetting, Automatic Tool Changers, Work Holding, cutting process parameter selection.

UNIT-II

CNC Programming: Part Programming Fundamentals, Manual Part Programming Methods, Preparatory Functions, Miscellaneous Functions, Explanation of G-Codes, Program Number, Tool Length compensation, canned cycles, cutter radius compensation.

UNIT- III

Turning center Programming: comparison between Machining centers and Turning centers, Tape Formats, Axes System, General Programming Functions, Motion commands, Cut Planning, Thread cutting, canned cycles.

UNIT-IV

CNC Turning: Plane Turing operation, Step Turing operation, Taper Turing operation, Thread Cutting operation, Multiple Turning operation.

UNIT-V

CNC Milling: Drilling operation, slotting operation**,** Profile Milling Model-I, Profile Milling Model-II, Circular Pocketing.

Text Books:

1. CAD/CAM Principles and Applications,P.N.Rao,Tata MC Graw Hill Publishing company Limited,New Delhi,publications 2016
2. CAD/CAM Concepts and Applications,Chennakesava R.Alavala,PHI Publishers,newdelhi 2011.
3. CAD/CAM Ibrahim Zeid,second edition Tata Mc Graw Hill

Reference Books:

1. Fundamentals of computer Aided Manufacturing, khushdeep Goyal. S.K.Kataria & Sons,
   August 2013.
2. CAD/CAM By Ashok Kumar Singh JBC Publication, New Delhi,2015.
3. CNC Programming by Ashok Kumar Singh ,JBC Publication ,NEW Delhi 2015.

B.Tech V SEM ME (R20)

Course Title	Heat Transfer					B.Tech ME V Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003501	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**			

Course Objectives:

- Understand different modes of heat transfer
- Gain knowledge about natural and force convection phenomenon
- Estimate experimental uncertainty in measurements
- Design heat and mass transfer equipment.
- Evaluate no. of stages required for given mass transfer problem.

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

CO 1	Apply the Basic laws of Heat transfer.
CO 2	Analyze the use of conductive heat tranfer and insulation.
CO 3	Apply the Knowldge of Fluid flow and themal flow of Convective Heat transfer.
CO 4	Evaluate the loss of thermal radiation.
CO 5	Compare different heat exchangers.

UNIT -I

Introduction: Basic modes of heat transfer- rate equations- generalized heat conduction equation - steady state heat conduction solution for plain and composite slabs - cylinders - critical thickness of insulation- heat conduction through fins of uniform cross section- fin effectiveness and efficiency.

Unsteady State Heat Transfer Conduction- Transient heat conduction- lumped system analysis and use of Heisler charts.

UNIT -II

Convection: Basic concepts of convection–heat transfer coefficients - types of convection – forced convection and free convection.

Free Convection -development of hydrodynamic and thermal boundary layer along a vertical plate – use of empirical relations for convective heat transfer on plates and cylinders in horizontal and vertical orientation

Forced convection- external flow–concepts of hydrodynamic and thermal boundary layer- use of empirical correlations for flow over plates and cylinders. Fluid friction – heat transfer analogy, approximate solution to laminar boundary layer equation for external flow. Internal flow – Use of empirical relations for convective heat transfer in horizontal pipe flow.

UNIT-III

Radiation: Radiation heat transfer – thermal radiation – laws of radiation - Black and Gray bodies – shape factor-radiation exchange between surfaces - Radiation shields - Greenhouse effect.

DESIGN OF HEAT TRANSFER EQUIPMENTS:

General design of heat exchange equipment, heat exchangers, condensers, boilers, types of evaporators.

UNIT-IV

Heat Exchangers: Types of heat exchangers- parallel flow- counter flow- cross flow heat exchangers- overall heat transfer coefficient- LMTD and NTU methods- fouling in heat exchangers.

UNIT-V

Boiling and Condensation: Different regimes of boiling- nucleate, transition and film boiling – condensation - filmwise and dropwise condensation.

Mass Transfer: Introduction **of** Conservation laws and constitutive equations - Fick's law of diffusion, isothermal equi-mass - Equimolal diffusion- - diffusion of gases and liquids-mass transfer coefficient.

.

Text Books:

1. P.K. Nag, Heat Transfer, 3/e, Tata McGraw-Hill, 2011.
2. J.P.Holman, Heat Transfer, 9/e, Tata McGraw-Hill,2008.
3. S. C. Arora& S. Domkundwar , A Course in Heat and Mass Transfer,DhanpatRai& CO.(P) LTD-Delhi , 2007.

Reference Books:

1. F. P. Incropera and D.P. Dewitt, Fundamentals of Heat and Mass Transfer, 6/e, John Wiley, 2007.
2. Cengel. A.Yunus, Heat Transfer- A Practical Approach, 4/e, Tata McGraw-Hill, 2007.
3. S.P. Sukhatme, A Textbook of Heat Transfer, Universities Press, 2005
4. Lienhard and Lienhard, A Heat and Mass Transfer, Cambridge Press, 2011.
5. C.P. Kothandaraman and S. Subramanyan, Heat and Mass Transfer databook, New Age Publications, 2014.

<table>
<tr><td>Course Title</td><td colspan="4">Design of Machine Members</td><td colspan="3">B.Tech ME 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">2003502</td><td rowspan="2">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>--</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>
</table>

Course Objectives:

. The students completing this course are expected:

- Provide an introduction to design of machine elements.
- Familiarize with fundamental approaches to failure prevention for static and dynamic loading.
- Explain design procedures to different types of joints.
- Teach principles of clutches and brakes and design procedures.
- Instruct different types of bearings and design procedures.

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

CO 1	Estimate safety factors of machine members subjected to static and dynamic loads.
CO 2	Design fasteners subjected to variety of loads.
CO 3	Select of standard machine elements such as keys, shafts, couplings, springs and bearings.
CO 4	Design clutches brakes and spur gears.
CO 5	Estimate safety factors of machine members subjected to static and dynamic loads.

UNIT-I

Mechanical Engineering Design: Design process, design considerations, codes and standards of designation of materials, selection of materials.

Design for Static Loads: Modes of failure, design of components subjected to axial, bending, torsional and impact loads. Theories of failure for static loads.

Design for Dynamic Loads: Endurance limit, fatigue strength under axial, bending and torsion, stress concentration, notch sensitivity. Types of fluctuating loads, Soderberg, Goodman and modified Goodman criterion for fatigue failure. Fatigue design under combined stresses.

UNIT- II

Design of Bolted Joints: Threaded fasteners, preload of bolts, various stresses induced in the bolts. Torque requirement for bolt tightening and eccentrically loaded bolted joints.

Welded Joints: Strength of lap and butt welds, Joints subjected to bending and torsion. eccentrically loaded welded joints.

UNIT- III

Power Transmission Shafts: Design of shafts subjected to bending, torsion and axial loading. Shafts subjected to fluctuating loads using shock factors.

Couplings: Design of flange and bushed pin flexible couplings.

POWER TRANSMISSIONS SYSTEMS, PULLEYS: Transmission of power by Belt and Rope drives, Belts – Flat and V types – Ropes - pulleys for belt and rope drives.

UNIT-IV

Friction Clutches: Torque transmitting capacity of disc and centrifugal clutches. Uniform wear theory and uniform pressure theory.

Brakes: Different types of brakes. Concept of self-energizing and self-locking of brake. Band and block brakes, disc brakes.

Springs: Design of helical compression, tension, torsion and leaf springs.

UNIT-V

Design of Sliding Contact Bearings: Lubrication modes, bearing modulus, Petroff and McKee's equations, design of journal bearing. Bearing Failures.

Design of Rolling Contact Bearings: Static and dynamic load capacity, equivalent bearing load, load factor, selection of bearings from manufacturer's catalogue.

Design of Gears: Spur gears, beam strength, Lewis equation, design for dynamic and wear loads.

Text Books:

1. R.L. Norton, Machine Design an Integrated approach, 2/e, Pearson Education, 2004.
2. V.B.Bhandari, Design of Machine Elements, 3/e, Tata McGraw Hill, 2010.
3. Dr. N. C. Pandya&Dr. C. S. Shah, Machine design, 17/e, Charotar Publishing House
4. Pvt. Ltd, 2009.

Reference Books:

1. R.K. Jain, Machine Design, Khanna Publications, 1978.
2. J.E. Shigley, Mechanical Engineering Design, 2/e, Tata McGraw Hill, 1986.
3. M.F.Spotts and T.E.Shoup, Design of Machine Elements, 3/e, Prentice Hall (Pearson Education), 2013.

<table>
<tr><td>Course Title</td><td colspan="5">Metrology and Measurements</td><td colspan="3">B.Tech ME 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">2003503</td><td rowspan="2">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>--</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>
</table>

Course Objectives:

. The students completing this course are expected:

- Introduce the basic concepts of metrology and measurement methods.
- Demonstrate the importance of metrology in manufacturing.
- Explain the concepts of. Screw thread measurements and gear tooth measurement.
- Expose various Principles and working of transducers.
- Familiarize in usage of appropriate device for measurements.

Course Outcomes:

- List various measuring instruments used in metrology.
- Examine surface and flatness measurements
- Examine geometry of screw threads and gear profiles
- Usage of transducers and guages
- Understand the types of devices for force and pressure measurement

CO 1	Assess the concept of different types of dimensional tolerances and fits.
CO 2	Explain the basic standards of measurements and application of slip gauges.
CO 3	Analyse the effective diameter of screw and gear tooth thickness, pressure angle by various methods.
CO 4	Evaluate various principles and working of transducers and measurement of displacement and strain.
CO 5	Identify the use of appropriate devices for measurement of force and pressure.

Note: Design data book is permitted.

UNIT-I

Concept of Measurement: General concept-generalized measurement system, units and standards, measuring instruments, sensitivity, readability, range of accuracy, precision, static and dynamic response, repeatability, systematic and random errors, terminologyoflimits, fits and tolerances, hole basis and shaft basis system, interchangeability, Selective Assembly

Limit Gauges and Gauge Design: Plug, Ring, Snap, Gap, Taper gauges. Taylor's principle.Design of Go and No Go gauges.

Linear and Angular Measurement: Line standards , end standards , Slip gauges , Angular Measurements by using Sine bar , angle gauges .

UNIT-II

Flatness Measurement: Measurement of flatness – straight edges – surface plates, optical flat, interferometers and their applications.

Surface Roughness Measurement: Terminology systems, differences between surface roughness and surface waviness- Numerical assessment of surface finish - CLA, R,M,S Values-Ra , Rz values, Methods of measurement of surface finish-profilograph, talysurf, BIS symbols for indication of surface roughness.

UNIT-III

Screw thread measurements: Elements of threads, errors in screw threads, Measurement of effective diameter- Two wire method ,Three wire metthod

Gear Measurement: Gear tooth terminology, measurement of gear elements-runout, lead, pitch backlash, profile, pressure angle, tooth thickness, diameter of gear, constant chord and base tangent method.

MACHINE TOOL METROLOGY: Alignment test on Lathe and Milling Machines.

UNIT-IV

Measurement of Displacement: Theory and construction of various transducers to measure displacement - Piezo electric, inductive, capacitance, resistance

Measurements of Strain: Requirement of strain gauge, resistance strain gauge, guage factor, strain gauge rosettes.

UNIT-V

Measurement of Force: Direct method - analytical balance, elastic members – load cells and proving rings.

Measurement of Pressure: Basic methods of pressure measurement, dead weight piston gauge, Elastic pressure transducers.

Text Books:

1. Beckwith, Marangoni, Linehard, Mechanical Measurements, 6/e, PHI, 2013.
2. R.K. Jain, Engineering Metrology, 20/e, Khanna Publishers, 2013.

Reference Books:

1. Mahajan, Engineering Metrology, 2/e, DhanpatRai, 2013.
2. S.Bhaskar, Basic Principles - Measurments and Control Systems, Anuradha Publications, 2014.
3. Anand K Bewoor&Vinay A Kulkarni, Metrology & Measurement, 15/e, McGrawHill, 2015.
4. ProductionTechnologybyR.K Jain, 6th edition, 2020.

<table>
<tr><td>Course Title</td><td colspan="5">Alternative Fuels and Emission Control in Auto motives</td><td colspan="3">B.Tech ME 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">2003504</td><td rowspan="2">PEC-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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:
. The students completing this course are expected:
- Explain various alcohol and gaseous fuels and their use in SI and CI engines.
- Explain various vegetable oils and their use in CI engines.
- Determine the formation of various emissions from SI engine and control techniques.
- Identify various emission measuring instruments and test procedures.

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

CO 1	Identify various emissions from SI and CI engines.
CO 2	Apply the properties of alcohol fuels and gaseous fuels.
CO 3	Predict the problems by using vegetable oils in diesel engines.
CO 4	Choose the use of various emission measuring instruments.
CO 5	Identify various emissions from SI and CI engines.

UNIT - I

Alcohol fuels and gaseous fuels: Alcohol fuels and gaseous fuels: Properties of alcohols, alcohol – gasoline blends, fuel flexible vehicle, methanol reformed gas engine, dual fuel system, Spark assisted diesel engine, surface ignition engine, ignition accelerators, performance, combustion and emission characteristics in SI and CI engines, Properties of hydrogen, production and storage methods, safety precautions, biogas production and its properties, properties of LPG and CNG, Performance, combustion and emission characteristics of hydrogen, biogas, LPG and CNG in SI and CI engines

UNIT - II

Vegetable oils: Vegetable oils: Various vegetable oils for diesel engines, structure and properties, problems in using vegetable oils in diesel engines, Methods to improve the engine performance using vegetable oils – preheating, Esterification , blending with good secondary fuels, Semi-adiabatic engine, surface ignition engine, ignition accelerators dual fuelling with gaseous and liquid fuels coils, Performance, combustion and emission characteristics of biodiesel fuelled diesel engines

UNIT - III

Emissions from SI engines and their control Emissions from SI engines and their control: Emission formation in SI engines (CO, HC and NOx), Effect of design and operating variables on emission formation, Control techniques – Thermal reactor, exhaust gas recirculation, Three way catalytic convertor and Charcoal canister control for evaporative emission, Positive crank case ventilation for blow by gas control.

UNIT - IV

Emissions from CI engines and their control:

Emissions from CI engines and their control: Emission formation in CI engines (HC, CO, NOx, Aldehydes, smoke and particulates), Effect of design and operating variables on emission formation, Control techniques – Exhaust gas recirculation, NOx selective catalytic reduction, Diesel oxidation catalytic convertor, Diesel particulate filter, NOx versus particulates – Trade off.

UNIT - V

Emission measuring instruments and test procedures Emission measuring instruments and test procedures: Principle of operation of emission measuring instruments used in SI and CI engines, Measurement of CO2 and CO by NDIR, Hydrocarbon emission by FID, Chemiluminescentanalyser for NOx, Liquid and Gas chromatograph Spot sampling and continuous indication type smoke meters (Bosch, AVL and Hartridge smoke meters) emission test procedures – FTP, Euro and Bharat norms.

Text Books:

1. Ganesan V, Internal combustion engines, 4th Edition, Tata McGraw Hill Education, 2012
2. Thipse.S.S, Alternative Fuels: Concepts, Technologies and Developments, Jaico Publishing House, 2010.

Reference Books:

1. Michael F. Hordeski, Alternative Fuels: The Future of Hydrogen, The Fairmont Press, 2008
2. R.K.Rajput, A textbook of Internal Combustion Engines, 2nd Edition, Laxmi Publications, 2007
3. “Society of Automotive Engineers”, Alternative Fuels: Fuel Cells and Natural Gas, Society of Automotive Engineers, Incorporated, 2000

<table>
<tr><td>Course Title</td><td colspan="5">Automation and Robotics</td><td colspan="3">B.Tech ME 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">2003505</td><td rowspan="2">PEC-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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- Describe the basic concepts of automation in manufacturing systems.
- Acquire the fundamental concepts of automated flow lines and their analysis.
- Classify automated material handling, automated storage and retrieval systems.
- Illustrate adaptive control systems and automated inspection methods.
- Define the fundamental concepts of industrial robotics.
- Apply basic mathematics to calculate the robot kinematic and dynamic mechanics
- Understand the robot programming methods and software packages. .

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

CO 1	Examine the types of hardware components of automation and control system
CO 2	Design a simple material handling system for low cost manufacturing.
CO 3	Design a simple gripper for robot.
CO 4	Compare the types of actuators used in robot manipulator
CO 5	Summarize the requirements and features of robot programming

UNIT – I

Introduction

Introduction: Automation in production system, need, types, Principles and Strategies of automation, levels of automation, basic elements of an automated system, hardware components for automation and process control, mechanical feeders, hoppers, orienters, high speed automatic insertion devices.

Automated flow lines & transfer mechanisms, fundamentals of transfer Lines, flow lines with or without buffer storage.

UNIT - II

Assembly Line Balancing and Automated Manufacturing System

Assembly Line Balancing: Assembly process and systems assembly line, line balancing algorithms, ways of improving line balance, flexible assembly lines.

Material handling and Identification Technologies: Overview of automatic material handling systems, principles and design consideration, material transport systems, storage systems, overview of automatic identification methods.

Automated Manufacturing Systems: Components, classification and overview of manufacturing systems, manufacturing cells, GT and cellular manufacturing, FMS and its planning and implementation.

UNIT - III

Introduction to Robotics

Introduction: Brief history of robots, classification of robot, functional line diagram, degrees of freedom. Elements of robot - types and its functions, factors to be considered in the design of grippers.

Robot Actuators And Feedback Components: Actuators, Pneumatic, Hydraulic actuators, Electric & Stepper motors, comparison. Position sensors - potentiometers, resolvers, encoders - velocity sensors, Tactile sensors, Proximity sensors.

UNIT - IV

Kinematics and Dynamics of a Manipulator Manipulator Kinematics

Homogenous transformations as applicable to translation, rotations- D-H notation, Forward and inverse kinematics.

Manipulator Dynamics: Differential transformations, Jacobians, Lagrange - Euler and Newton - Euler formations.

UNIT - V

Robot Programming and Applications

Robot Programming: Methods of programming - requirements and features of programming languages, software packages, problems with programming languages. Motion path control-slew motion, joint integrated motion, straight line motion; avoidance of obstacles.

Robot Application in Manufacturing: Material Transfer - Material handling, loading and unloading; Process - spot and continuous arc welding & spray painting; Assembly and Inspection.

Text Books:

1. MikellP.Groover, Automation, Production Systems and Computer Integrated Manufacturing- Pearson Education.5/e, 2009.
2. Mikell P. Groover and Mitchell Weiss, Roger N. Nagel, Nicholas G.Odrey , Industrial Robotics — McGraw Hill, 1986.

Reference Books:

1. S. R. Deb &Sankha Deb, Robotics Technology and Flexible Automation, Tata McGraw-Hill Education.
2. R K Mittal and I J Nagrath, Robotics and control, Illustrated Edition, Tata McGraw Hill India 2003.

3. Saeed B. Niku, Introduction to Robotics – Analysis, System, Applications, 2nd Edition, John Wiley & Sons, 2010.
4. Richard D. Klafter, Thomas Robotic Engineering an integrated approach, PHI publications 1988.

<table>
<tr><th>Course Title</th><th colspan="5">Tool Design</th><th colspan="3">B.Tech ME V Sem (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">2003506</td><td rowspan="2">PEC-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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:
The objectives of this course are to

- Design Tools that can withstand all forces acting on them.
- Design tools which reduce downtime and hence increase production.
- Select the tool material that increases the tool life.
- Provide simple and smooth, easy operation machine tools to maximize the efficiency.
- To produce the components of high quality that required fewer secondary operations on them.

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

CO 1	Determine the cutting tool geometry, mechanism of chip formation and mechanics of orthogonal cutting.
CO 2	Identify basic parts and operations of machine tools including lathe, shaper, planer, drilling, boring, milling and grinding machine.
CO 3	Design locating and clamping devices to produce a component.
CO 4	Select a machining operation and corresponding machine tool for a specific application in real time
CO 5	Select a measuring instrument to inspect the dimensional and geometric features of a given component

UNIT – I

INTRODUCTION TO TOOL DESIGN

Introduction –Tool Engineering – Tool Classifications– Tool Design Objectives – Tool Design in manufacturing- Challenges and requirements- Standards in tool design-Tool drawings - Surface finish – Fits and Tolerances - Tooling Materials- Ferrous and Non ferrous Tooling Materials- Carbides, Ceramics and Diamond -Non metallic tool materials-Designing with relation to heat treatment.

UNIT - II

DESIGN OF CUTTING TOOLS

Mechanics of Metal cutting –Oblique and orthogonal cutting- Chip formation and shear angle - Single-point cutting tools – Milling cutters – Hole making cutting tools- Broaching Tools - Design of Form relieved and profile relieved cutters-Design of gear and thread milling cutters.

UNIT - III

DESIGN OF JIGS AND FIXTURES

Introduction – Fixed Gages – Gage Tolerances –selection of material for Gauges – Indicating Gages – Automatic gages – Principles of location – Locating methods and devices – Principles of clamping – Drill jigs – General considerations in the design of drill jigs – Drill bushings –

Methods of construction –Types of Fixtures – Vice Fixtures – Milling Fixtures – Boring Fixtures – Broaching Fixtures.

UNIT - IV

DESIGN OF PRESS TOOL DIES

Types of Dies –Method of Die operation–Clearance and cutting force calculations- Blanking and Piercing die design – Pilots – Strippers and pressure pads- Presswork materials – Centre of pressure -Strip layout – Short-run tooling for Piercing – Bending dies – Drawing dies-Design and drafting.

UNIT - V

TOOL DESIGN FOR CNC MACHINE TOOLS

Introduction –Tooling requirements for Numerical control systems – Fixture design for CNC machine tools- Sub plate and tombstone fixtures-Universal fixtures– Cutting tools– Tool holding methods– Automatic tool changers and tool positioners – Tool presetting– General explanation of the Brown and Sharp machine.

Text Books:

1. Cyrll Donaldson, George H.LeCain, V.C. Goold, "Tool Design", Tata McGraw Hill Publishing Company Ltd., 2000.
2. E.G.Hoffman," Jig and Fixture Design", Thomson Asia Pvt Ltd, Singapore, 2004.

Reference Books:

1. PrakashHiralal Joshi, "Tooling data", Wheeler Publishing, 2000 .
2. Venkataraman K., "Design of Jigs, Fixtures and Presstools", TMH, 2005.
3. Haslehurst M., "Manufacturing Technology", The ELBS, 1978.
4. Online Learning Resources

<table>
<tr><th>Course Title</th><th colspan="5">Power Plant Engineering</th><th colspan="3">B.Tech ME V Sem (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">2003507</td><td rowspan="2">PE</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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- 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.

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

CO 1	Outline sources of energy, power plant economics, and environmental aspects.
CO 2	Describe working of a steam power plant and their components
CO 3	Illustrate the working mechanism of Diesel and Gas turbine power plants.
CO 4	Understand the various elements of hydroelectric power plant and their types
CO 5	Summarize types of renewable energy sources and their working principle.

UNIT- I

Introduction to the Sources Of Energy - Resources and Development of Power in India. Layouts of Steam, Hydel, Diesel, MHD, Nuclear and Gas Turbine Power Plants - Combined Power Cycles - Comparison and Selection.

Power Plant Economics and Environmental Considerations: Capital Cost, Investment of Fixed Charges, Operating Costs, General Arrangement of Power Distribution, Load Curves, Load Duration Curve. Definitions of Connected Load, Maximum Demand, Demand Factor, Average Load, Load Factor, Diversity Factor - Tariff - Related Exercises.

UNIT –II

Steam Power Plant : Modern High Pressure and Supercritical Boilers - Analysis of Power Plant Cycles - Modern Trends in Cycle Improvement - Waste Heat Recovery, Fluidized Bed Boilers., Fuel and Handling Equipments, Types of Coals, Coal Handling, Choice of Handling Equipment, Coal Storage, Ash Handling Systems.

Steam Power Plant :Construction- Dust Collectors, Cooling Towers And Heat Rejection. Analysis of Pollution from Thermal Power Plants - Pollution Controls.

UNIT –III

Diesel Power Plant: Diesel Power Plant: Introduction - IC Engines, Types, Construction- Plant

Layout with Auxiliaries - Fuel Storage

GAS TURBINE PLANT: Introduction - Classification - Construction - Layout with Auxiliaries - Principles of Working Closed and Open Cycle Gas Turbines. Advantages And Disadvantages Combined Cycle Power Plants.

UNIT- IV

Hydro Electric Power Plant: Water Power - Hydrological Cycle / Flow Measurement - Drainage Area Characteristics - Hydrographs - Storage and Pondage - Classification of Dams and Spill Ways.

Hydro Projects & Plant: Classification - Typical Layouts - Plant Auxiliaries - Plant Operation Pumped Storage Plants.

UNIT- V

Power From Non-Conventional Sources: Utilization of Solar Collectors- Principle of its Working, Wind Energy - Types of Turbines - HAWT & VAWT-Tidal Energy. MHD power Generation.

Nuclear Power Station: Nuclear Fuel - Nuclear Fission, Chain Reaction, 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, Gas Cooled Reactor, Radiation Hazards and Shielding - Radioactive Waste Disposal.

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, 6/e, Laxmi Publications, 2020.
2. Ramalingam, Power plant Engineering, Scietech Publishers, 2019
3. P.C. Sharma, Power Plant Engineering, S.K. Kataria Publications, 2019.

<table>
<tr><th>Course Title</th><th colspan="4">Non-Destructive Testing</th><th colspan="3">B.Tech ME V Sem (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">2003508</td><td rowspan="2">PEC-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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- Introduce basic concepts of non-destructive testing.
- Familiarize with characteristics of ultrasonic test, transducers, rejection and effectiveness.
- Describe concept of liquid Penetrant, eddy current and magnetic particle tests, its applications and limitations.
- Explain the principles of infrared and thermal testing, applications and honey comb and sandwich structures case studies.
- Impart NDE and its applications in pressure vessels, casting and welded constructions.

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

CO 1	Predict various methods of non-destructive testing.
CO 2	Apply relevant non-destructive testing method different applications.
CO 3	Explain the applications of Railways, Nuclear and chemical industries.
CO 4	Outline the limitations and disadvantages of NDE.
CO5	Explain the applications of NDA of pressure vessels, casting and welding constructions.

UNIT - I

Introduction to non-destructive testing

Introduction to non-destructive testing: Radiographic test, Sources of X and Gamma Rays and their interaction with Matter, Radiographic equipment, Radiographic Techniques, Safety Aspects of Industrial Radiography.

UNIT – II

Ultrasonic test Ultrasonic test

Principle of Wave Propagation, Reflection, Refraction, Diffraction, Mode Conversion and Attenuation, Sound Field, Piezo-electric Effect , Ultrasonic Transducers and their Characteristics, Ultrasonic Equipment and Variables Affecting Ultrasonic Test, Ultrasonic Testing, Interpretations and Guidelines for Acceptance, Rejection - Effectiveness and Limitations of Ultrasonic Testing.

UNIT - III

Liquid penetrant, Eddy Current & Magnetic Particle Test

Liquid Penetrant Test: Liquid Penetrant Test, Basic Concepts, Liquid Penetrant System, Test Procedure, Effectiveness and Limitations of Liquid Penetrant Testing.

Eddy Current Test: Principle of Eddy Current, Eddy Current Test System, Applications of Eddy Current-Testing Effectiveness of Eddy Current Testing.

Magnetic Particle Test: Magnetic Materials, Magnetization of Materials, Demagnetization of Materials, Principle of Magnetic Particle Test, Magnetic Particle Test Equipment, Magnetic Particle Test Procedure, Standardization and Calibration, Interpretation and Evaluation, Effective Applications and Limitations of the Magnetic Particle Test.

UNIT – IV

Infrared & Thermal Testing Infrared And Thermal Testing

Introduction and fundamentals to infrared and thermal testing–Heat transfer –Active and passive techniques –Lock in and pulse thermography–Contact and non contact thermal inspection methods–Heat sensitive paints –Heat sensitive papers –-thermally quenched phosphors liquid crystals –techniques for applying liquid crystals –other temperature sensitive coatings –Inspection methods –Infrared radiation and infrared detectors–thermo mechanical behavior of materials–IR imaging in aerospace applications, electronic components, Honey comb and sandwich structures–Case studies.

UNIT - V

Industrial Applications of NDE

Industrial Applications of NDE: Span of NDE Activities Railways, Nuclear, Non-nuclear and Chemical Industries, Aircraft and Aerospace Industries, Automotive Industries, Offshore Gas and Petroleum Projects, Coal Mining Industry, NDE of pressure vessels, castings, welded constructions.

Text Books:

1. J Prasad, GCK Nair , Non destructive test and evaluation of Materials, Tata mcgraw-Hill Education Publishers, 2008.
2. Josef Krautkrämer, Herbert Krautkrämer, Ultrasonic testing of materials, 3/e, Springer-Verlag, 1983.
3. X. P. V. Maldague, Non destructive evaluation of materials by infrared thermography, 1/e, Springer-Verlag, 1993.

Reference Books:

1. Gary L. Workman, Patrick O. Moore, DoronKishoni, Non-destructive, Hand Book, Ultrasonic Testing, 3/e, Amer Society for Nondestructive, 2007.

<table>
<tr><td>Course Title</td><td colspan="5">Disaster Management</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">20OE101</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 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.</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	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>
</table>

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.

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

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.

<table>
<tr><td>Course Title</td><td colspan="5">Building Materials</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">20OE103</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>
</table>

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>ourse
Title</td><td colspan="5">Modern Control Theory</td><td colspan="3">B. Tech. EEE
Open Elective - 1</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">20OE201</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: 1Hr30M</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: Students are able to learn the State Space, Describing function, phase plane and stability analysis including controllability and observability.</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 concept of State Space Techniques</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the stability of linear and nonlinear Systems</td></tr>
<tr><td>CO 3</td><td colspan="8">Construct the state model of Linear Time Invariant systems and Lyapunov functions for nonlinear systems</td></tr>
<tr><td>CO 4</td><td colspan="8">Determine Eigen values state transition matrix and examine the controllability and observability of linear time invariant systems</td></tr>
<tr><td>CO 5</td><td colspan="8">Design state feedback controller and observer</td></tr>
</table>

UNIT – I

State variable descriptions: Concepts of state, state variables, state vector, state space model, representation in state variable form, phase variable representation.

UNIT – II

Solution of State Equations: diagonalization –state transition matrix – properties - .solution of state equations of homogeneous and non-homogeneous systems.

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,

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 Lyapunov - stability of linear system – methods of constructing Lyapunov 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="4">Programming Fundamentals for Numerical Computations</td><td colspan="4">B. Tech. EEE
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">20OE202</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: 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 make the students familiar with scripts, functions, control flow and plotting and use them to solve various 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 basic features, arrays and symbolic algebra.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze various control flow structures, interpolation and curve fitting</td></tr>
<tr><td>CO 3</td><td colspan="8">Solve linear equations, Polynomials</td></tr>
<tr><td>CO 4</td><td colspan="8">Plot two-dimensional and three-dimensional graphics</td></tr>
</table>

UNIT-I

Basics Fundamental Features: Basic features, script M-files, code cells, arrays creation, addressing and array operations; multi dimensional arrays.

UNIT-II

Control Flow: Arithmetic & Logical operators, control flow - if, if-else, for, while, switch case constructions and functions.

UNIT-III

Mathematical Operations: Matrix algebra and solutions to systems of linear equations, polynomials, Numerical integration, numerical differentiation

UNIT-IV

Graphics & Numerical techniques: Two-dimensional graphics, basics of three-dimensional graphics, interpolation, curve fitting.

UNIT-V

Symbolic Mathematics: Symbolic algebra, equation solving, differentiation and integration.

Text Books

1. Hanselman and Littlefield, "Mastering MATLAB 7", Pearson Education Etter,
2. Kuncickly, Hull, "Introduction to MATLAB 6", Pearson Education.

<table>
<tr><td>Course Title</td><td colspan="4">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>
<tr><td>CO 1</td><td colspan="8">Understand the types of Microcontrollers.</td></tr>
<tr><td>CO 2</td><td colspan="8">Define various components and list out various features of microcontrollers.</td></tr>
<tr><td>CO 3</td><td colspan="8">Describe the various blocks of 8051, MSP 430, PIC and ARM microcontrollers</td></tr>
</table>

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="4">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="3">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>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: 3Hrs</td></tr>
<tr><td colspan="9">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="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 variety of abstract data types and data structures.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze data structures such as linked list, Stacks and Queues.</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply and analyze tree traversal algorithms and graph traversal algorithms.</td></tr>
<tr><td>CO 4</td><td colspan="8">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="5">Database Management Systems
(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="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 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, and managing the database.
● To develop an understanding of essential DBMS concepts such as: database secur 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 transactionexecution.</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.

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”, 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 Management Systems.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 Education, 2006.

Reference Links:

1. https://nptel.ac.in/courses/106/105/106105175/ (IIT KHARAGPUR)
2. https://nptel.ac.in/courses/106/106/106106095/ (IIT MADRAS)

<table>
<tr><td>Course Title</td><td colspan="4">DATA STRUCTURES
(Open Elective Course – I)</td><td colspan="3">B.Tech. V 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">20OE3901</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>
</table>

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:** SingleLinked 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, Completeand 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 andRadhika 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.

Web links:

1. **https://nptel.ac.in/courses/106102064**
2. **https://nptel.ac.in/courses/106103069**

<table>
<tr><td>Course Title</td><td colspan="4">OOP THROUGH C++
(Open Elective Course – I)</td><td colspan="4">B.Tech. V 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">20OE3902</td><td rowspan="2">PJ</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="4">Mid Exam Duration: 90 Min</td><td colspan="5">End Exam Duration: 3Hrs</td></tr>
</table>

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++ programming language.

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 a class, 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, Purevirtual functions.

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

Templates: Class Templates, Function Templates, Overloading Template functions, Member function Templates.

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

Text Books:

1. The Complete Reference C++, Herbert Schildt, TMH 4^{th} Edition.
2. Learning - Computer Science :A Structured Approach Using C++,2nd Ed., Forouzan, Thomson.
3. Object Oriented Programming With C++, E. Balagurusamy, TMH 6^{th} 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><td>Course Title</td><td colspan="4">Employability Skills</td><td colspan="3">B.Tech.
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">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>

Introduction:

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

i. 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, Oxford University Press, 2011.

5. Managing Soft Skills for Personality Development – edited by B.N.Ghosh, McGraw Hill 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="4">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:

1. To solve algebraic, transcendental equations and system of linear equation by various methods.
2. To interpolate and approximate equal and unequal intervals by various formulae.
3. To discuss approximation of numerical differentiation and integration.
4. To solve Ordinary Differential Equations (ODEs) in initial value problems (IVPs) by various methods.
5. 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.

<table>
<tr><td>Course Title</td><td colspan="4">ENGINEERING MATERIALS</td><td colspan="4">OPEN ELECTIVE- 2</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"></td><td rowspan="2">BSC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End lab 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>
</table>

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).

<table>
<tr><td>Course Title</td><td colspan="4">Basics of Nanotechnology</td><td colspan="3">B. Tech.
(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">20OE604</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>
</table>

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 i 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.

Learning Outcomes:
At the end of the unit, The students will be able to

- Classification of nanomaterials.
- Identify different structures of nanomaterials.

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

Learning Outcomes:
At the end of the unit, The students will be able to

- Explain Sol-gel method.
- Discuss electrochemical and chemical methods of synthesis.

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.

Learning Outcomes:
At the end of the unit, The students will be able to

- Explain methods used in fabrication of different nanomaterials

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

Learning Outcomes:
At the end of the unit, The students will be able to

- Explain the importance of nano particles.
- Discuss the effect of size on different properties.

Unit-5: Applications of Nanomaterials

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

Learning Outcomes:
At the end of the unit, The students will be able to

- Know the applications of nanomaterials in different fields.

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>
<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">Utilize effective techniques for writing job applications /course application.</td></tr>
<tr><td>CO 2</td><td colspan="8">Recall the contents to make use of good paragraph writing.</td></tr>
<tr><td>CO 3</td><td colspan="8">Identifying grammatical errors and can make necessary corrections.</td></tr>
<tr><td>CO 4</td><td colspan="8">Demonstrate effective grammatical skills in English.</td></tr>
<tr><td>CO 5</td><td colspan="8">Paraphrase a piece of writing and summarize it easily.</td></tr>
</table>

Syllabus:

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.
2. Bailey, Stephen. Academic writing: A handbook for international students. Routledge, 2014.
3. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.Oxford Learners Dictionary, 12 th Edition, 2011

<table>
<tr><td>Course Title</td><td colspan="5">Human Capital Management</td><td colspan="3">B.Tech. Open Elective-1</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">20OE606</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
• 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.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO1</td><td colspan="8">UnderstandingofrolesandresponsibilitiesofHRdepartmentinindustries.</td></tr>
<tr><td>CO2</td><td colspan="8">Have knowledge to understand job analysis and design jobs.</td></tr>
<tr><td>CO3</td><td colspan="8">Understand job evaluation and estimate HR requirements.</td></tr>
<tr><td>CO4</td><td colspan="8">Able to conduct recruitment & selection process.</td></tr>
<tr><td>CO5</td><td colspan="8">Abletounderstandtrainingmethods.Haveclarityofemployeecompensation</td></tr>
</table>

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,OxfordUniversityPress

<table>
<tr><th>Course Title</th><th colspan="5">Metrology and Measurements Laboratory</th><th colspan="3">B.Tech ME V Sem (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">2003514</td><td rowspan="2">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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:
. The objectives of this course are to

- To experiment with measuring equipment's used for linear and angular measurements.
- To find common types of errors in measurement equipment.
- To experiment with different types of sensors, transducers and strain gauges equipment.

To make use of thermocouples for measurement of temperature.

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

CO 1	Apply different instruments to measure length, width, depth, bore diameters, internal and external tapers, tool angles, and surface roughness.
CO 2	Measure effective diameter of thread profile.
CO 3	Conduct different machine alignment tests.
CO 4	Evaluate temperature, displacement, and pressure.
CO 5	Illustrate different instruments to measure length, width, depth, bore diameters, internal and external tapers, tool angles, and surface roughness.

Section A:

1. Measurement of bores by internal micrometers and dial bore indicators.
2. Use of gear teeth vernier callipers and checking the chordal addendum and chordal height of spur gear.
3. Alignment test on milling machine using dial indicators
4. Study of Tool makers microscope and its application
5. Angle and taper measurements by Bevel protractor, Sine bars, spirit level etc.
6. Thread measurement by Two wire/Three wire method.
7. Alignment test on the lathe using dial indicators
8. Use of straight edge and sprit level in finding the flatness of surface plate.

Section B:

1. Calibration of Pressure Gauges
2. Study and calibration of vacuum gauge for low pressure.
3. Calibration of transducer or thermocouple for temperature measurement.
4. Calibration of LVDT transducer for displacement measurement.

5. Calibration of capacitive transducer for angular measurement.
6. Calibration of photo and magnetic speed pickups for the measurement of speed.
7. Calibration of discharge by using rota meter

<table>
<tr><th>Course Title</th><th colspan="4">Heat Transfer Laboratory</th><th colspan="3">B.Tech ME V Sem (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">2003515</td><td rowspan="2">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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- Understand different modes of heat transfer
- Gain knowledge about natural and force convection phenomenon
- Estimate experimental uncertainty in measurements

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

CO 1	Demonstrate different modes of heat transfer.
CO 2	Develop parameters for measurement for calculating heat transfer.
CO 3	Determine effectiveness of heat exchanger.
CO 4	Design new equipment related to heat transfer.
CO 5	Use principles of heat transfer in wide application in industries.

LIST OF EXPERIMENTS:

1. Determine the overall heat transfer coefficient across the width of composite wall
2. Determine the thermal conductivity of a metal rod
3. Determine the thermal conductivity of insulating powder material through concentric sphere apparatus
4. Determine the thermal conductivity of insulating material through lagged pipe apparatus
5. Determine the efficiency of a pin fin.
6. Determine the heat transfer coefficient for a vertical cylinder in natural convection
7. Determine the heat transfer coefficient in forced convection of air in a horizontal tube.
8. Determine the heat transfer coefficients on film and drop wise condensation apparatus.
9. Determine the effectiveness of a parallel and counter flow heat exchanger.
10. Determine the emissivity of the test plate surface.
11. Experiment on Stefan-Boltzmann apparatus.

<table>
<tr><td>Course Title</td><td colspan="5">ANSYS (Skill oriented course– III)</td><td colspan="3">B.Tech ME 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">2003516</td><td rowspan="2">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>0</td><td>2</td><td>2</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>
</table>

Course Objectives:

. The objectives of this course are to

- This is an introductory course on Finite element Analysis
- using ANSYS and is specially meant for
- ANSYS is a popular and well recognised general purpose.
- Finite element modelling package for numerically solving a large range of problems including. static, dynamic mechanical, structural analysis.

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

CO 1	Can able to understand the considerations that are important in the planning of a useful an appropriate analysis model.
CO 2	Analyse the Various Machine Techniques and Methods
CO 3	Construct Geometry for Analysis.
CO 4	Solve the Engineering Design Problems.

LIST OF EXPERIMENTS:

- Structural analysis of simply supported beam
- Structural analysis Cantilever Beam
- Structural analysis of Bars of constant cross sectional area
- Stress analysis of a rectangular plate with a circular hole
- Stress analysis of a corner angle Bracket
- Thermal Analysis of Composite wall
- Dynamic analysis of bar subjected to forcing function

PART-B

- Static structural analysis of screw jack using ANSYS WORK BENCH
- Steady state analysis of simple plate using ANSYS WORK BENCH

<table>
<tr><td>Course Title</td><td colspan="4">Constitution of India
(Mandatory Course)</td><td colspan="3">B.Tech. V Sem -R20
(ME,CSE & EEE)</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">20MC509</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>00</td><td>40</td></tr>
<tr><td colspan="6">Mid Exam Duration: 2Hrs</td><td colspan="3">External Exam Duration: –</td></tr>
</table>

Course Objectives: The main objective of the course to learn

- To realize the significance of the constitution of India to students from all walks of life and help them to understand the basic concepts of Indian constitution.
- To identify the importance of fundamental rights as well as fundamental duties.
- To understand the functioning of Union, State and Local Governments in the Indian federal system.
- To learn procedure and effects of emergency, composition and activities of election commission and amendment procedure.

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

CO1	Describe the historical background of the constitution making and its importance for building a democratic India.
CO2	Explain the functioning of three wings of the government i.e., executive, legislative and judiciary.
CO3	Explain the value of the fundamental rights and duties for becoming good citizen of India.
CO4	Analyze the decentralization of power between central, state and local self-government.
CO5	Apply the knowledge in strengthening of the constitutional institutions like CAG, Election Commission and UPSC for sustaining democracy.

UNIT - I

Introduction to Indian Constitution: Constitution meaning of the term, Indian Constitution – Sources and constitutional history, Features – Citizenship, Fundamental Rights and Duties, Directive Principles of State Policy.

UNIT - II

Union Government and its Administration Structure of the Indian Union: Center-State relationship, President: Role, power and position, PM and Council of ministers, Cabinet and Central Secretariat, LokSabha, RajyaSabha, The Supreme Court and High Court: Powers and Functions.

UNIT - III

State Government and its Administration Governor – Role and Position – CM and Council of ministers, State Secretariat: Organization, Structure and Functions.

UNIT - IV

Local Administration: District's Administration Head – Role and Importance, Municipalities – Mayor and role of Elected Representative – ZillaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy – (Different departments), Village level – Role of Elected and Appointed officials.

UNIT - V

Election Commission: Election Commission- Role of Chief Election Commissioner and Election Commissioner State Election Commission:, Functions of Commissions for the welfare of SC/ST/OBC and women.

Text Books:

1. M.V.Pylee, "Introduction to the Constitution of India",4th Edition, Vikas publication,2005.
2. Durga Das Basu(DD Basu) , "Introduction to the constitution of India",(Student Edition),19th edition, Prentice-Hall EEE, 2008.

Reference Books:

1. Durga Das Basu, Introduction to the Constitution of India, Prentice – Hall of India Pvt. Ltd.. New Delhi
2. Subhash Kashyap, Indian Constitution, National Book Trust
3. J.A. Siwach, Dynamics of Indian Government & Politics
4. D.C. Gupta, Indian Government and Politics
5. H.M.Seervai, Constitutional Law of India, 4th edition in 3 volumes (Universal Law Publication)
6. J.C. Johari, Indian Government andPolitics Hans
7. J. Raj IndianGovernment and Politics
8. M.V. Pylee, Indian Constitution Durga Das Basu, Human Rights in Constitutional Law, Prentice – Hall of India Pvt. Ltd.. New Delhi
9. Noorani, A.G., (South Asia Human Rights Documentation Centre), Challenges t o Civil Right), Challenges to Civil Rights Guarantees in India, Oxford University Press 2012.

E-Resources:

- nptel.ac.in/courses/109104074/8
- nptel.ac.in/courses/109104045/
- nptel.ac.in/courses/101104065/
- www.hss.iitb.ac.in/en/lecture-details
- www.iitb.ac.in/en/event/2nd-lecture-institute-lecture-series-indian-constitution

Course Title	Socially Relevant Projects (community based project)					B.Tech ME V Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003517	**PROJ**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		--	**--**	**-**	**1.5**	**100**	**--**	**100**

Course Objective: The objective of the project is to enable the student to take up investigative study in rural areas in the field of MECHANICAL Engineering

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	Illustrate 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 Socially Relevant Projects:

1. The student has to spend 50 to 60 Hrs in the semester on any socially relevant project and submit a report for evaluation.
2. 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.
3. A student shall acquire 1.5 credits assigned, when he/she secures 50% or more marks from the total of 100 marks.
4. In case, if a student fails, he/she shall resubmit the report.
5. There is no external evaluation for the socially relevant project.

B.Tech VI SEM ME (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Operation Research</td><td colspan="3">B.Tech ME VI 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">2003601</td><td rowspan="2">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>--</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>
</table>

Course Objectives:

. The objectives of this course are to

- To impart the basic concepts of modeling, models and statements of the operations research.
- Formulate and solve linear programming problem/situations.
- Model strategic behaviour in different economic situations.
- To solve transportation problems to minimize cost.
- Apply Queuing theory to solve problems of traffic congestion, counters in banks, railway bookings etc.
- Explain scheduling and sequencing of production runs and develop proper replacement policies.

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

CO 1	Develop mathematical models for practical problems.
CO 2	Apply linear programming to transportation & Assignment problems.
CO 3	Solve game theory & Sequencing using various techniques.
CO 4	Solve Queueing and inventory problems.
CO 5	Apply replacement models to real life problems.

UNIT - I

Introduction to OR

Introduction to Operations Research (OR): OR definition - Classification of Models, modeling – Methods of solving OR Models, limitations and applications of OR models

Linear Programming(LP): Problem Formulation, Graphical Method, Simplex Method, Big-M Method, Two–Phase Simplex Method, - Degeneracy, Optimal Solutions; Concept of dual theorem

UNIT - II

Transportation and Assignment Problems

Transportation and Assignment Problems: Transportation Problem – Formulation; Different Methods of Obtaining Initial Basic Feasible Solution –North West Corner Rule, Least Cost Method, Vogel's Approximation Method; Optimality Method – Modified Distribution (MODI) Method; Special Cases – Unbalanced Transportation Problem, Degenerate Problem. Assignment Problem – Formulation, Hungarian Method for Solving Assignment Problems, Traveling Salesman problem.

UNIT – III

Game theory & Job Sequencing:

Game theory: Optimal solution of two person zero sum games, the max min and min max principle. Games without saddle points, mixed strategies.Reduction by principles of dominance, arithmetic, algebraic method and graphical method.

Job Sequencing: Introduction to Job shop Scheduling and flow shop scheduling, Solution of Job Sequencing Problem, Processing of n Jobs through two machines, Processing of n Jobs through m machines, graphical method.

UNIT - IV

Queuing Theory & Inventory Control

Queuing Theory: Introduction – Terminology, Arrival Pattern, Service Channel, Population, Departure Pattern, Queue Discipline, Single Channel Models with Poisson Arrivals, Exponential Service Times with infinite and finite queue length; Multichannel Models with Poisson Arrivals, Exponential Service Times with infinite queue length.

Inventory Control: Introduction, Deterministic models – EOQ model with and without shortages, Production model, Buffer stock and discount inventory models with single price breaks. Selective inventory control.

UNIT - V

Replacement and Maintenance Analysis & DP

Replacement and Maintenance Analysis: Introduction – Types of Maintenance, Make or buy decision. Types of Replacement Problems, Determination of Economic Life of an Asset, and Simple Probabilistic Model for Items which completely fail-Individual Replacement Model, Group Replacement Model.

Dynamic Programming (DP): Introduction –Bellman's Principle of Optimality – Applications of Dynamic Programming, Solution of Linear Programming Problem by DP.

Text Books:

1. Sharma S.D., Operations Research: Theory, Methods and Applications, 15th Edition, KedarNath Ram Nath, 2018.
2. Taha H.A., Operations Research, 9th Edition, Prentice Hall of India, New Delhi, 2020.

<u>**Reference Books**:</u>

1. Hiller F.S., and Liberman G.J., Introduction to Operations Research, 7th Edition, Tata McGraw Hill, 2010.
2. Sharma J.K., Operations Research: Theory and Applications, 4th Edition, Laxmi Publications, 2009.
3. Prem kumar Gupta and Hira, Operations Research, 3rd Edition, S Chand Company Ltd., New Delhi, 2003.
4. Pannerselvam R., Operations Research, 2nd Edition, Pentice Hall of India, New Delhi, 2006.
5. Sundaresan.V, and GanapathySubramanian.K.S, Resource Management Techniques: Operations Research, A.R Publications, 2015.

<table>
<tr><td>Course Title</td><td colspan="4">Finite Element Methods</td><td colspan="3">B.Tech ME VI 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">2003602</td><td rowspan="2">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>--</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>
</table>

Course Objectives:
The objectives of this course are to
- Familiarize basic principles of finite element analysis procedure.
- Explain theory and characteristics of finite elements that represent engineering structures.
- Apply finite element solutions to structural, thermal, dynamic problem.
- Learn to model complex geometry problems and solution techniques.

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

CO 1	Understand the concepts of variational methods and weighted residual methods in FEM. Formulation of I-D Bar Elements.
CO 2	Identify the application and characteristics of FEA elements such as Formulation and Analysis to solve Trusses, beams
CO 3	Develop element characteristic equation procedure and generation of global stiffness equation will be applied for Modelling of 2D stress Analysis of CST Elements. stress-strain Relation matrics [D], Strain-Displacement matrics [B]
CO 4	Understand the concept of Iso peramatric Formulation and its classification,1-D Heat transfer problems of Composite slab, Fin problems and Numerical Integrations.
CO 5	Able to identify how the finite element method expands beyond the structural domain, for problems involving formulations of dynamic Analysis.

UNIT - I

Introduction to finite element methods

Introduction to finite element methods, Basic steps for solving field problems, applications, Stress and equilibrium, Boundary conditions, Strain-Displacement relations, Stress- strain relations for 2D and 3D Elastic problems. Variation Methods, Potential energy Method, Rayleigh-Ritz method,Galerkin's and Weighted Residual Methods.Formulation of Finite Element Equations.

One dimensional Problem: Finite element modeling of ID bar elements coordinates and shape functions. Requirements for Convergence and Interpolation functions, Assembly of global stiffness matrix and load vector. Finite element equations, Treatment of boundary conditions, Quadratic shape functions.

UNIT - II

Analysis of Trusses and Beams

Analysis of trusses: Stiffness Matrix for 1D truss element, Assembling of Global Stiffness Matrix and Calculations of Reactions, Displacements and Stresses .Problems with maximum of three elements.

Analysis of beams: Element Stiffness Matrix and Load vector for 1-D beam element, Hermite shape functions and Solutions for Displacements, Reactions and Stresses of simple problems.

UNIT - III

Finite element modeling Finite element modeling of two dimensional stress analysis with constant strain triangles (CST), Shape functions of CST Elements and Stress Strain Relation Matrix (D) and Strain Displacement Matrix (B). Estimation of load Vector, Stresses. Finite element modeling of Axi-symmetric problems subjected to axi-symmetric loading with triangle elements.

UNIT - IV

Quadrilateral Elements

Quadrilateral Elements: Isoparametric, Sub parametric and Super parametric elements, modeling of 4 noded and 8 noded quadrilateral elements and simple problems. Numerical Integration.Steady state heat transfer analysis: One dimensional analysis of composite slab and fin.

UNIT - V

Dynamic analysis

Dynamic analysis: Formulation of finite element model, element – mass matrices, evaluation of Eigen values and Eigen vectors for a bar and shaft.

Text Books:

1. Chandraputla, Ashok &Belegundu, Introduction to Finite Element in Engineering, Prentice Hall.
2. S.S.Rao, The Finite Element Methods in Engineering, Elsevier Butterworth - Heinemann 2nd Edition, 2011.
3. O C Zienkiewicz and R L Taylor, the Finite Element Method, 3rd Edition. McGraw-Hill, 1989.

Reference Books:

1. J N Reddy, An introduction to the Finite Element Method, McGraw – Hill, New York, 1999.
2. S.Md.Jalaludeen, Finite Element Analysis in Engineering, 2nd Edition, Anuradha Publications, 2018.
3. R D Cook, D S Malkus and M E Plesha, Concepts and Applications of Finite Element

Analysis, 3rd Edition, John Wiley, New York, 1989.

4. K J Bathe, Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs,1982.
5. G.Lakshmi Narasaiah, Finite Element Analysis, 1st Edition, B.S. Publications, 2008.

Course Title	Introduction to CAD/ CAM					B.Tech ME VI Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003603	**PCC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 MIN						**End Exam Duration: 3Hrs**		

Course Objective:

- The course examines the area that is commonly referred to as CAD/CAM
- The general objectives of the course are to enable the students Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings,
- Understand the basic analytical fundamentals that are used to create and manipulate.
- Understand the possible applications of the CAD/CAM systems in motion analysis, structure analysis, optimization, rapid prototyping, reverse engineering and virtual engineering.
- Understand concept of Group Technology, FMS and CIM

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

CO 1	Understand Fundamentals, Computer peripherals, Applications and benefits of CAD .
CO 2	Solve various Line generation, transformations, windowing and clipping concepts
CO 3	Analyze various curve generation concepts. wireframe, surface, solid modelling, CSG,B-rep, CSG, Bezier curve and surface representations
CO 4	Understand GT,FMS,Applications of robots in manufacturing and material handling
CO 5	Identify Various CAPP.MRP. capacity planning. Automatic identification methods, barcode technology concepts.

UNIT-I

Fundamentals of CAD - design process - Applications of computers for design benefits of CAD - Computer peripherals for CAD - Design work station.

COMPUTER GRAPHICS:

Raster scan graphics coordinate system, database structure for graphics modeling, Transformation of geometry, 3D transformations, mathematics of projections, clipping, hidden surface removal.

UNIT-II

Geometry and line generation, Computer graphics: Transformations- Points and lines transformation - Translation, rotation, Scaling, Mirror Reflection; 2D and 3D transformations -Windowing and Clipping.

UNIT-III

Curve generation - Plane curves - Space curves - Surface description and generation; modeling concepts: 2D and 3D modeling - Wire frame, Surface and Solid modeling. B-rep solid modeling and constructive solid geometry, Bezier curve and surface representations.

UNIT-IV

CAM - Definition, Divisions of CIM: Group technology - Introduction, concepts of GT, Analysis of GT, Classification and coding system, Advances of GT, Flexible manufacturing systems (FMS) - Definition, Different flexibilities Need of FMS, Components of FMS, system and FMS, Advantages of FMS. Applications of robots in manufacturing and material handling.

UNIT-V

Computer Aided Process Planning- Variant and Generative CAPP Systems. MRP- Inputs and outputs of MRP, Capacity Planning Basic concepts of Shop floor data- Types of factory data and collection systems- concepts of automatic identification methods- Bar code technology- Concepts and uses.

Text Books:

1. CAD/CAM, A Zimmers& P.Groover, PE, PHI ,2012
2. Computer-Aided Design and Manufacturing 1st Edition (English, Paperback, E. Zimmers, M. Groover). 2010.
3. Introduction to Automated Process Planning" by T C Chang and R A Wysk. 2012
4. 3.CAD/CAM By Ibrahim Zeid ,R.siva subramanyam ,Mcgraw Higher Ed.

Reference Books:

1. Computer Graphics :PlastockSchaum Series,2006
2. Interactive Computer Graphics: Newman &Sproul,2012
3. Computer Graphics: Steven Hamington

<table>
<tr><th>Course Title</th><th colspan="5">Dynamics of Machinery</th><th colspan="3">B.Tech ME VI Sem (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">2003604</td><td rowspan="2">PEC-II</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: 90 MIN</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- To introduce the laws of precession.
- To learn about the working of different types of brakes and dynamometers,
- To able to design the fly wheel for an IC engine,
- To introduce different types of Governors,
- To analyze the unbalanced forces acting in rotating and reciprocating system and to know the balancing methods of different mechanical systems..

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

CO 1	Solve the numerical problems on brakes and understand the working of Dynamometers
CO 2	Apply gyroscopic principles on aero planes, ships, four wheel and two wheel vehicles.
CO 3	Analyze the basics of Governors and forces acting on various governors.
CO 4	Evaluate the numerical problems on Balancing of Rotating masses and reciprocating masses.
CO 5	Design the response of single degree freedom systems with free and forced vibration, and can Evaluate the critical speed of the shaft.

UNIT -I

BALANCING: Balancing of rotating masses- single and multiple masses- single and different planes Balancing of Reciprocating masses- Primary and secondary balancing of reciprocating masses-graphical methods. Unbalanced forces and couples-V-engine, multi cylinder in line and radial engine for primary and secondary balancing.

UNIT-II

TURNING MOMENT DIAGRAMS AND FLYWHEELS: Turning moment diagrams for IC engine and multi cylinder engine. Crank effort- coefficient of fluctuation of energy, coefficient of fluctuation of speed-Fly wheels and their design, fly wheels for punching machines.

UNIT -III

GOVERNORS: Watt, Porter and Proell governors. Spring loaded governors- Hartnell and Hartung governors with auxiliary springs. Sensitiveness, isochronism and hunting.Effort and power of agovernor.

UNIT -IV

BRAKES AND DYNAMOMETERS: Simple block brakes, Band brake, internal expanding brake, braking of vehicle. Dynamometers- absorption and transmission types. General description and methods of operation.

PRECESSION: Gyroscopes, effects of precession motion on the stability of moving vehicles such as motor car, motorcycle, aero planes

UNIT-V

VIBRATION: Free and forced vibration of single degree of freedom system, Role of damping, Whirling of shafts and critical speeds. Simple problems on free, forced and damped vibrations.Vibrationisolation & Transmissibility. Transverse vibrations of beams with concentrated and distributed loads. Dunkerly'smethod. Torsional vibrations-two and three rotor systems.

Text Books:

1. Thoery of Machines, S.S Ratan, MGH
2. Theory of machines, Khurmi, S.Chand.
3. Kinematics and Dynamics of machinery-R.L.NORTON,TATA MC GRAW HILL
4. Theory of machines- J.E.SHIEGLEY, MC GRAW HILL

Reference Books:

1. Theory of machines,THOMOS BEVAN, PEARSON PUBL, 3RD EDITION
2. Mechanism and mechanics :Mchal.M.StanisicCengageindia publishers 1st edition
3. Theory of Machines and Mechanism ,JOHN VICKY J.VR,GORDON R.PENNOK JOSEPH 5TH EDITION OXFORD PUBLICATION
4. Design of machine elments , M.F.SPOTS ,TE,SOUP 8TH EDITION PEARSON

Course Title	Solar And Wind Energy Systems					B.Tech ME VI Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003605	**PEC-II**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**0**	**--**	**3**	**40**	**60**	**100**
Mid Exam Duration: 90 MIN					**End Exam Duration: 3Hrs**			

Course Objectives:

. The objectives of this course are to

- 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.
- Familiarize the wind energy sources assessment
- Explain basics of designing aerofoil

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

CO 1	Determine the basic concepts of solar radiation and solar collectors .
CO 2	Design the solar photo voltaic systems for different applications.
CO 3	Identify wind energy as alternative form of energy and to know how it can be tapped.
CO 4	Use the application of wind energy and wind energy conversion systems.
CO 5	Utilize different wind parameters for design of rotors.

UNIT - I

Solar radiation and collectors

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.

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 - II

Solar PV fundamentals

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-photovoltaics.

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 - standalone - hybrid and grid connected system - System installation - operation and maintenances - field experience - PV market analysis and economics of SPV systems.

UNIT - III

Introduction to wind energy

Introduction: Historical Perspectives on Wind Turbines- Indian Energy Scenario - Global Energy Scenario - Introduction to Indian Wind Industry - Wind Energy potential of India and Global Wind Installations.

Basics of Wind Resource Assessment: Power in the wind –Wind Characteristics - Measurement of wind using anemometers (cup anemometer, propeller anemometer, pressure plate anemometer, pressure tube anemometer, sonic anemometer and other remote wind speed sensing techniques) –Turbulence-Wind Power Density –Average wind speed calculation - Statistical models for wind data analysis (Weibull and Rayleigh distribution). Energy estimation of wind regimes – Wind Rose, Wind Monitoring Station Siting and Instrumentation.

UNIT - IV

Wind Energy Conversion Systems

Wind Energy Conversion Systems: Types - Components of Modern Wind Turbine (HAWT and VAWT) - Fixed and Variable Speed operations - Power Control (Passive stall, Active pitch, Passive pitch and Active stall) - Electrical aspects of wind turbine, Safety of wind turbines.

UNIT - V

Wind Farm Design and Health (Condition) Monitoring

Wind Farm Design and Health (Condition) Monitoring: Planning of wind farm, Site selection, Micro siting, Grid Integration, Power evacuation, Wind Farm Feasibility Studies, Preparation of DPR, Environmental Benefits and Impacts.

Small Wind Turbines: Water pumping wind mills, offshore wind energy, Wind turbine testing, future developments.

Text Books:

1. Goswami D.Y., Kreider, J. F. and Francis., “Principles of Solar Engineering’, Taylor and Francis, 2000.
2. Chetan Singh Solanki, “Solar Photovoltaics – Fundamentals, Technologies and Applications”, PHI Learning Private limited, 2011.
3. Satyajit Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).

Reference Books:

1. Sukhatme S.P..Nayak.J.P, ‘Solar Energy – Principle of Thermal Storage and collection”, Tata
   McGraw Hill, 2008.
2. Satyajit Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).
3. Sathyajith Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).
4. Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press, (2010.
5. Wind Power, Revised Edition: Renewable Energy for Home, Farm, and Business, Paul Gipe, 2004, Chelsea Green Publishing.
6. A. R. Jha, Wind Turbine Technology, CRC Press, (2010).

<table>
<tr><td>Course Title</td><td colspan="5">Computational Fluid Dynamics</td><td colspan="3">B.Tech ME VI 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">2003606</td><td rowspan="2">PEC-II</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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- Teach the basics of the major theories, approaches and methodologies used in CFD.
- Familiar with the differential equations for flow phenomena and numerical methods for their solutions.
- Introduce explicit and implicit schemes in hyperbolic equations.
- Expose the students to solve the problems through finite volume method.
- Understand the concepts of linear fluid flow problems, steady state problems and transient problems.

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

CO 1	Examine the major theories, approaches and methodologies used in CFD.
CO 2	Formulate finite volume method for two and three dimensional fluid flow problems.
CO 3	Apply numerical models to fluid flow and heat transfer calculations.
CO 4	Demonstrate the ability to communicate the results of this detailed fluid-flow study in a written format.
CO 5	Outline the ability to describe various flow features in terms of appropriate fluid mechanical principles and force balances.

UNIT - I

Introduction

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

Solution methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes, alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT - II

Hyperbolic equations

Hyperbolic equations: explicit schemes and Von Neumann stability analysis, implicit schemes, multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT - III

Formulations of Incompressible Viscous Flows

Formulations Of Incompressible Viscous Flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Treatment of compressible flows: potential equation, Euler equations, Navier-stokes system of equations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT - IV

Finite Volume Method

Finite Volume Method: Finite volume method via finite difference method, formulations for two and three-dimensional problems.

UNIT – V

Standard Variational Methods

Standard Variational Methods: Linear fluid flow problems, steady state problems, Transient problems.

Textbooks:

1. Computational fluid dynamics/ T. J. C'hung/ Cambridge University press,2002.
2. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ McGraw Hill.

Reference Books:

1. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985.
2. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hemashava Publishers corporation & McGraw Hill.
3. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications.
4. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
5. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis / Oxford.

<table>
<tr><td>Course Title</td><td colspan="5">Six Sigma and Lean Manufacturing</td><td colspan="3">B.Tech ME VI 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">2003607</td><td rowspan="2">PEC-II</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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- Introduce the students, the basic concepts of six sigma and lean manufacturing.
- Expose with various quality issues in Inspection.
- Gain Knowledge on quality control and its applications to real time.
- Know the extent of cellular manufacturing and 5S.

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

CO 1	Demonstrate various techniques that are related to the six-sigma and lean manufacturing.
CO 2	Outline the concepts of cellular manufacturing, JIT and TPM.
CO 3	Illustrate the principles and implementation of 5S techniques.
CO 4	Select procedure and principles of value stream mapping.
CO 5	Determine the reliability function using six-sigma.

UNIT - I

Introduction to Six-Sigma

Introduction to Six-Sigma-Probabilistic models-Six Sigma measures-Yield-DPMO-Quality level-Reliability function using Six-Sigma-MTTF using Six Sigma-Maintenance free operating period- Availability using Six-Sigma-Point availability-Achieved availability-Operational Availability-Examples

UNIT - II

The Elements of Six Sigma and their Determination

The Elements of Six Sigma and their Determination-The Quality Measurement Techniques: SQC, Six Sigma, Cp and Cpk- The Statistical quality control (SQC) methods-The relationship of control charts and six sigma-The process capability index (Cp)-Six sigma approach-Six sigma and the 1.5 σ shift-The Cpk Approach Versus Six Sigma-Cpk and process average shift- Negative Cpk-Choosing six sigma or Cpk-Setting the process capability index-Examples.

UNIT - III

Introduction To Lean Manufacturing:

Introduction To Lean Manufacturing: Conventional Manufacturing versus Lean Manufacturing – Principles of Lean Manufacturing – Basic elements of lean manufacturing – Introduction to LM Tools.

UNIT - IV

Cellular Manufacturing, JIT, TPM

Cellular Manufacturing, JIT, TPM :Cellular Manufacturing – Types of Layout, Principles of Cell layout, Implementation. JIT – Principles of JIT and Implementation of Kanban. TPM – Pillars of TPM, Principles and implementation of TPM.

UNIT - V Set Up Time Reduction, TQM, 5S, VSM 10,Set up time reduction – Definition, philosophies and reduction approaches. TQM – Principles and implementation. 5S Principles and implementation - Value stream mapping - Procedure and principles.

Textbooks:

1. U Dinesh Kumar, Crocker, Chitra and HaritheSaranga, Reliability and Six Sigma, Springer Publishers.

2. Sung H. Park, Six Sigma for Quality and Productivity Promotion, Asian Productivity Organization

3. Rother M. and Shook J, 1999 ‗Learning to See: Value Stream Mapping to Add Value and Eliminate Muda' , Lean Enterprise Institute, Brookline, MA.

Reference Books:

1. Sammy G. Shina, Six Sigma for Electronics Design and Manufacturing, McGraw-Hill.

2. Design and Analysis of Lean Production Systems, Ronald G. Askin& Jeffrey B. Goldberg, John Wiley & Sons, 2003.

3. Mikell P. Groover (2002) ‗Automation, Production Systems and CIM.

<table>
<tr><th>Course Title</th><th colspan="5">Energy Auditing</th><th colspan="3">B.Tech ME VI Sem (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">2003608</td><td rowspan="2">PEC-II</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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

. The objectives of this course are to

- 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	Summarize the fundamental aspects of energy scenario in India.
CO 2	Analyze the various national and state level energy policy.
CO 3	Develop the concepts of energy conservation in boilers.
CO 4	Select the thermal energy components.
CO 5	Illustrate the concepts of supply 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">Solid Waste Management</td><td colspan="3">B.Tech CE VI Sem (R20)</td></tr>
<tr><td>CourseCode</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">20OE104</td><td rowspan="2">Open Elective (OEC II)</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>
</table>

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.

<table>
<tr><td>Course Title</td><td colspan="4">Estimation and Costing</td><td colspan="3">B.Tech CE VI Sem (R20)</td></tr>
<tr><td rowspan="3">Course Code

20OE105</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td rowspan="2">Open Elective (OEC II)</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>
</table>

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.

<u>UNIT – IV</u>

Valuation

Introduction, Technique of Valuation, Elements of Valuation and Factors Affecting Valuation, Methods of Valuation to the Land Property and Building Property, Mortgage.

<u>UNIT – V</u>

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.

<u>Text Books:</u>

1. B N Dutta "Estimating and Costing in Civil Engineering", U B S Publishers Distributers Pvt. 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

<u>Reference Books:</u>

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	Energy Conversion Systems					B. Tech. EEE Open Elective - II		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE203	**Open Elective (OEC)**	**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 about energy conversion techniques, sources of electrical energy production and impact of energy conversion systems on environment.

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

CO 1	Understand various energy conversion systems, fuel cells & batteries
CO 2	Analyze solar and wind energy conversion process
CO 3	Illustrate Ocean Energy Conversion systems
CO 4	Explain the environmental effects of Energy Conversion Systems.

UNIT I

Photo Voltaic 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 of Tidal project - Turbines and Generators for Tidal Power generation.

Ocean Thermal Energy Conversion: Types of ocean thermal energy conversion systems, Application of OTEC systems examples.

UNIT IV

Miscellaneous Energy Conversion Systems: Biomass conversion, Geothermal energy, Thermo electric energy conversion: Seebeck effect, Peltier and Thomson effects and their coefficients – Thermo-Electric Generator – Peltier Cooling

UNIT V

Fuel Cells & Batteries: Introduction - principles of EMF generation - description of fuel cells - Batteries, Description of batteries, Battery applications for large power.

Environmental Effects: Environmental Effects of Energy Conversion Systems, Pollution from coal and preventive measures - steam stations and pollution - pollution free energy systems.

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).

<table>
<tr><td>Course Title</td><td colspan="4">Smart Grid</td><td colspan="3">B. Tech. EEE
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">20OE204</td><td rowspan="2">Open Elective Course (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: 1Hr30M</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The student is able to learn fundamentals, Architecture and analysis of smart grid with communication, networking and measuring technologies involved in it.</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 features, fundamental components and architecture of smart grid</td></tr>
<tr><td>CO 2</td><td colspan="8">Explain information, communication and networking technologies involved with the smart grid</td></tr>
<tr><td>CO 3</td><td colspan="8">Explain operation and importance of PMU, WAMPS and smart storage systems in smart grid</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze Microgrid with various concepts and challenges in future</td></tr>
</table>

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 - Phase Measurement Unit (PMU).

UNIT – 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.
3. James Momoh, “Smart Grid: Fundamentals of Design and Analysis”- Wiley, IEEE Press, 2012.

Reference Books

1. A.G. Phadke and J.S. Thorp, “Synchronized Phasor Measurements and their Applications”, Springer Edition, 2e, 2017.
2. James Northcote, Green, Robert G. Wilson “Control and Automation of Electric Power Distribution Systems (Power Engineering)”, CRC Press.
3. Andres Carvallo, John Cooper, “The Advanced Smart Grid: Edge Power Driving Sustainability”, Artech House Publishers July 2011.
4. 4. Clark W Gellings, “The Smart Grid, Enabling Energy Efficiency and Demand Side Response”- CRC Press, 2009.

<table>
<tr><td>Course Title</td><td colspan="5">Introduction to VLSI</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">20OE403</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>
</table>

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="4">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="4">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>
</table>

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	Develop efficient programs with multitasking ability and handle exceptions.
CO 3	Develop user friendly interface.
CO 4	Create AWT components.

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="5">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.

<table>
<tr><td>Course Title</td><td colspan="4">OPERATING SYSTEMS
(Open Elective Course – II)</td><td colspan="3">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">20OE3903</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: 3Hrs</td></tr>
<tr><td colspan="9">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</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO1</td><td colspan="8">Understand the basic concepts related to the operating systems</td></tr>
<tr><td>CO2</td><td colspan="8">Analyze the various process scheduling algorithms and process synchronization mechanisms.</td></tr>
<tr><td>CO3</td><td colspan="8">Analyze the various memory management schemes.</td></tr>
<tr><td>CO4</td><td colspan="8">Understand the ways to deal the deadlocks and the basic concepts related to files in the system.</td></tr>
<tr><td>CO5</td><td colspan="8">Analyze the protection and security mechanism.</td></tr>
</table>

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 Access Matrix, Implementation of Access Matrix.

Text Books:

1. Abraham Silberchatz, Peter B. Galvin, Greg Gagne, Operating SystemConcepts", Eighth edition, John Wiley.

2. Andrew S Tanenbaum, “Modern Operating Systems”, Fourth Edition, PearsonEducation.
3. William Stallings, “Operating Systems: Internals and Design Principles”, SixthEdition2009, 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, 4th 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>
</table>

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.

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 transaction execution.

UNIT – I

Introduction - Database-System Applications, View of Data, Database languages, Databasearchitecture, 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 TransactionAtomicity 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", PearsonEducation, 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 ManagementSystems,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 Education, 2006.

Reference Links:

1. https://nptel.ac.in/courses/106/105/106105175/ (IIT KHARAGPUR)

2. https://nptel.ac.in/courses/106/106/106106095/ (IIT MADRAS)

<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>
</table>

Course Outcomes: On successful completion of this course, the students will be able to	
CO 1	**Understand** and calculate the measures of dispersion
CO 2	**Analyze** probability concepts
CO 3	**Apply** distributions in real life problems.
CO 4	**Justify** hypothesis concepts
CO 5	**Estimate** correlation and regression coefficients

UNIT I:
Introduction, Mean, Median, Mode, Skewness, Range

Learning Outcomes:
At the end of this unit, the student will be able to

- understand and calculate the measures of dispersion

UNIT II:
Probability Basics, Simple probabilities, Rule of addition, Rule of multiplication, Conditional Probability, Baye's theorem.

Learning Outcomes:
At the end of this unit, the student will be able to

- analyze probability concepts

UNIT III:
Explaining basic concepts of Random Variables (Without Problems)- Probability Distributions: Binomial distribution**,** Poisson distribution**,** Normal distribution**,** Real life problems

Learning Outcomes:
At the end of this unit, the student will be able to

- apply distributions in 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.

Learning Outcomes:

At the end of this unit, the student will be able to

- justify hypothesis concepts

UNIT V:

Introduction, Linear Regression, Correlation coefficient, Coefficient of determination, Root Mean Square Error.

Learning Outcomes:

At the end of this unit, the student will be able to

- estimate correlation and regression coefficients

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, 9th 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.

<table>
<tr><td rowspan="1">Course Title</td><td colspan="4">BASICS OF ELECTRICAL, MAGNETIC AND OPTOELECTRONIC MATERIALS</td><td colspan="3">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">20OE608</td><td rowspan="2">BSC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End lab 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>
</table>

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 colspan="2">Course Title</td><td colspan="5">Corrosion and Control</td><td colspan="3">B. Tech.
(Open elective-II)</td></tr>
<tr><td colspan="2">Course Code</td><td>Category</td><td colspan="3">Hours/Week</td><td>Credits</td><td colspan="3">Maximum Marks</td></tr>
<tr><td colspan="2" 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="6">Mid Exam Duration: 90 Min</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="10">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="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">Recall the concepts of corrosion and its mechanism.</td></tr>
<tr><td>CO 2</td><td colspan="9">Explore different forms of corrosion and its mechanisms & prevention methods.</td></tr>
<tr><td>CO 3</td><td colspan="9">Analyze different factors which influence corrosion in different medium</td></tr>
<tr><td>CO 4</td><td colspan="9">Identify different control methods for efficient control of corrosion</td></tr>
<tr><td>CO 5</td><td colspan="9">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..

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain the types of corrosion.
- Identify the factors which influence corrosion.

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)

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain the mechanisms and prevention methods of different forms of corrosion.
- Analyze the differences between pitting and galvanic corrosion.

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.

Learning Outcomes:

At the end of the unit, The students will be able to

- discuss various environmental factors which influence the corrosion

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.

Learning Outcomes:

At the end of the unit, The students will be able to

- explain the prevention methods of corrosion
- discuss the basic concepts of electroplating and electroless plating

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.

Learning Outcomes:

At the end of the unit, The students will be able to

- Analyze the rate of corrosion
- Explain the importance of Electrochemical series

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, 3rd 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

<table>
<tr><td>Course Title</td><td colspan="4">Academic Writing</td><td colspan="3">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">20OE615</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>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>
</table>

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 2002 or latest edition)
2. Stephen Bailey Academic Writing: A Handbook for International Students

Reference Books:

3. A Short Guide to College Writing, 5th edition, by Barnet, Bellanca, and Stubbs.
4. 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.
5. 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>
</table>

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.

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

CO 1	Knowledge of the basics of Financial Management Concepts.
CO 2	To learn the concept of cost of capital and making decisions regarding raising of capital
CO 3	To understand the concept of Capital structure evaluation and related decisions.
CO 4	To build knowledge about financing and estimation of Working capital management.
CO 5	To understand the concepts of TVM, capital budgeting decisions and evaluation of Projects.
CO 6	Understanding of mergers, acquisitions and various other types financial restructurings

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 edition.
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><th>Course Title</th><th colspan="4">Computer Aided drafting Laboratory</th><th colspan="3">B.Tech ME VI Sem (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">2003610</td><td rowspan="2">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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- To train the students with CAD packages.
- To impart the 2D and 3D modeling skills to the students.
- To import and export different IGES files from one software to another
- Apply basic concepts to develop construction (drawing) techniques
- Ability to manipulate drawings through editing and plotting techniques

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

CO 1	Design different parts of mechanical equipment’s.
CO 2	Apply their skills in various designing and Manufacturing Industries.
CO 3	Analyze different parts of mechanical equipment’s
CO 4	Illustrate the skills in various designing and Manufacturing Industries.

List of Experiments:

1. Generation of the following curves using “C”/ Python language

   a) Bezier curves

2. Generation of the following surfaces using “C”/Python language

   a) B-Spine surfaces

3. Typical tasks of Modeling using any solid modeling packages such as PRO/E, IDEAS, CATIA, etc.,

   a) Solid Boolean algebra - 1 Exercise

   b) Wireframe &Surface Modelling – 3 Exercises

   c) 3D – Drafting in detail – 1 Exercise

   d) Production Drawing with Geometric Dimensioning and Tolerances– 3 Exercises

(Preferably for the assembly drawings drawn in Computer Aided Machine Drawing in previous semester)

References Books:

1. James D Meadows "Geometric Dimensioning and Tolerancing-Applications, Analysis & Measurement ASME Y14.5-2018.

2. KL Narayana, P Kannaiah and K.Venkat Reddy, Production Drawing, New Age publishers, 2014.

3. Ibrahim Zeid, Tata McGraw hill, CAD/CAM Theory and Practice.

Online Learning Resources/Virtual Labs:

1. https://www.youtube.com/watch?v=77EIAPpoe5k

2.https://www.youtube.com/watch?v=YkxPwpqTyjEhttps://www.youtube.com/watch?v=er7xJFKv5k&list=PL5w7L_xR0pu2wLbJtOuK49WxJJVjiyKks&index=2

3. https://www.youtube.com/watch?v=Gy0MKabzDa8&list=PLrOFa8sDv6jccqLnN7UDa1YW4s_hR6YX

4. https://www.youtube.com/watch?v=k3kFC9uTdUk&list=PLM5xm8DJKViImdv5ZXxQ2NyIdSlid_jCB

<table>
<tr><td>Course Title</td><td colspan="5">Solid works</td><td colspan="3">B.Tech ME VI 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">2003611</td><td rowspan="2">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="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
• To train the students with solid works packages.
• To impart the 2D and 3D modeling skills to the students.
• To import and export different IGES files from one software to another
• Apply basic concepts to develop construction (drawing) techniques
• Ability to manipulate drawings through editing and plotting 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">Design the 3 D modelling by understanding the underlying concepts.</td></tr>
<tr><td>CO 2</td><td colspan="8">Analyze the working simulation of 3D assemblies.</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply the basic commands to create solid models.</td></tr>
<tr><td>CO 4</td><td colspan="8">Illustrate the assembly of multiple parts.</td></tr>
</table>

Introduction: Solid Works Graphical User Interface - Feature manager design tree, Callouts, Handles

Sketch Entities – Inference line, Centerline line, Line, Circle, Arc, Ellipse, Rectangle, Slots, Polygon, Ellipse, Partial Ellipse, Spline, Points, Text, Construction geometry.

1. Study of solid works using cad

2. Draw 2D profile using solid works using Sketecher Mode.

3. Draw 3D profile using solid works using Extrude.

4. Draw 3D profile using solid works using Draft ,loft.

5. Draw 3D profile using Edit commands

6. Draw 3D profile In assembly mode

    EX-1

    EX-2

7. 3D Modeling of Machine elements like flanged coupling.

Reference Books:

1. James D Meadows "Geometric Dimensioning and Tolerancing-Applications, Analysis & Measurement ASME Y14.5-2018.

2. KL Narayana, P Kannaiah and K.Venkat Reddy, Production Drawing, New Age publishers, 2014.

3. Ibrahim Zeid, Tata McGraw hill, CAD/CAM Theory and Practice.

Online Learning Resources/Virtual Labs:

1. https://www.youtube.com/watch?v=77EIAPpoe5k

2.https://www.youtube.com/watch?v=YkxPwpqTyjEhttps://www.youtube.com/watch?v=er7xJFKv5k&list=PL5w7L_xR0pu2wLbJtOuK49WxJJVjiyKks&index=2

3. https://www.youtube.com/watch?v=Gy0MKabzDa8&list=PLrOFa8sDv6jccqLnN7UDa1YW4s_hR6YX

4. https://www.youtube.com/watch?v=k3kFC9uTdUk&list=PLM5xm8DJKViImdv5ZXxQ2NyIdSlid_jCB

<table>
<tr><td>Course Title</td><td colspan="5">Soft Skills Lab
(Skill Oriented Course)</td><td colspan="3">B.Tech ME VI 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">20246S4</td><td rowspan="2">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>0</td><td>2</td><td>2</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 objectives of this course are to make the students
Encourage all round development of the students by focusing on soft skills
Outline the required skills such as interpersonal skills, communication skills.
Aware of critical thinking and problem solving skills
Develop leadership skills and organizing skills through group activities
Function effectively with heterogeneous teams</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">Memorize various elements of effective communicative skills</td></tr>
<tr><td>CO 2</td><td colspan="8">Interpret the required skills such as interpersonal skills, communication skills.</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply critical thinking and problem solving skills</td></tr>
<tr><td>CO 4</td><td colspan="8">Develop leadership skills and organizing skills through group activities</td></tr>
<tr><td>CO 5</td><td colspan="8">Function effectively with heterogeneous teams</td></tr>
</table>

UNIT – I: Soft Skills

Introduction, meaning, Listing Soft Skills, significance of soft skills – Discussion on essential soft skills, methods to inculcate soft skills.

UNIT – II: Team Player Attitude

What is an Attitude – Attitude towards others – Importance of ‘Can Do’ Attitude – Openness to New Ideas – Work Behaviour.

UNIT – III: Problem Solving & Decision Making

Meaning & Features of Problem Solving - Managing Conflict – Conflict Resolution – Methods of Decision Making – Effective Decision Making in Teams – Methods and Styles.

UNIT – IV: Leadership Skills

Team Building – Decision Making – Accountability – Planning – Public Speaking – Motivation – Risk Taking – Time Management

UNIT – V: Work Ethics

Definition – Important work Ethics – Developing A Strong Work Ethic Nature in an Organization - Role and Importance of Working Ethics in a Workplace**.**

Suggested Software: Walden

Text Books:

1. Personality Development and Softskills (English, Paperback, Mitra Barun K.) Publisher : Oxford University Press; Pap/Cdr edition (July 22, 2012)
2. Soft Skills by Alex K. Published by S. Chand
3. Soft Skills: An Integrated Approach to Maximize Personality, Gajendra Singh Chauhan
4. Communication Skills and Soft Skills (Hardcover, A. Sharma) Publisher: Yking books
5. Soft Skills for a BIG IMPACT (English, Paperback, RenuShorrey) Publisher: Notion Press

Books Recommended:

1. Peggy Klaus, The Hard Truth about Soft Skills

2. The Ace of Soft Skills, Gopalswamy Ramesh, Mahadevan Ramesh, Pearson Education India.

3. Eric Garner – Team Building.

4. Carnegie Dale, How to Win Friends and Influence People, New York, Fireside Publishers, 1998

5. Soft Skills, 2015, Career Development Centre, Green Pearl Publications.

6. Convey Sean, Seven Habit of Highly Effective Teens, New York, Fireside Publishers,1998.

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Course Title	Management & Organizational Behavior (MC)					B.Tech. VI Sem (R20) (ME , EEE & CSE)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
20MC612	Humanities & Social Sciences (HSMC)	L	T	P	C	Continuous internal Assessment	End Exam	Total
		2	0	0	0	40	0	40
Mid Exam Duration: 2Hrs						External Exam Duration: 3Hrs		

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.

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

CO1	Explain the Importance & Role of Management in the Organizations.
CO2	Evaluate the different aspects related to Decision Making and Controlling Process
CO3	Describe the different theories related to Individual behavior in the Organization
CO4	Analyze Group Behavioral influence in the Organization.
CO 5	Evaluate the process and climate effects in Organization Behavior.

UNIT-I

Role of Management: Concept – Significance – Functions – Principles of Management - Patterns of Management: Scientific – Behavioural – 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 Behaviour& 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

OrganisationalBehaviour: Organizing Process – Departmentation Types – Making Organizing Effective – Organisational culture- Types of culture – Organisational Culture VsOrganisational climate - Conflict management - Change Management

Text Books:

1. Organisational Behaviour, Stephen P. Robbins, Pearson Education
2. Management and Organisational Behaviour, Subbarao P, Himalaya Publishing House
3. Principles of Management, Koonz,Weihrich and Aryasri, Tata McGraw Hill.

Reference Books:

1. Organisational Behaviour ,S.S.Khanka, S.Chand
2. Organisational Behaviour , Mishra .M.N ,Vikas
3. Management and Organisational behaviour, Pierce Gordner, Cengage.
4. Behaviour in Organizations, Hiriyappa .B.New Age Publications
5. Organisational Behaviour, Sarma, Jaico Publications.
6. Principles of Management ,Murugesan ,Laxmi Publications

Web Links:

www.esl-lab.com

www.englishmedialab.com

www.englishinteractive.net

B.Tech VII SEM ME (R20)

<table>
<tr><td>Course Title</td><td colspan="4">Modern Manufacturing Methods</td><td colspan="3">B.Tech ME 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">2003701</td><td rowspan="2">PEC-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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Define various Modern Machining Processes.
- Acquire knowledge in the elementary mechanism and machinability of materials with different Modern Machining Processes.
- Determine basic principles of operation for each process and their applications.
- State various parameters influencing MRR in Non – Traditional Machining Process.
- Classify and understand the working of Additive Manufacturing Processes.

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

CO 1	Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.
CO 2	Classify the mechanism of Mechanical Energy based machining processes, its applications and limitations.
CO 3	Differentiate Electrical Energy Based machining processes, mechanism of metal removal, machine tool selection.
CO 4	Interpret Electro Chemical machining process, economic aspects of ECM and problems on estimation of metal removal rate.
CO 5	Illustrate advanced machining processes, cutting tools and cutting fluids for a specific material and part features.

UNIT -I

NEED FOR MODERN MANUFACTURING METHODS

Non-traditional machining methods and rapid prototyping methods - their relevance for precision and lean manufacturing.Classification of non-traditional processes - their selection for processing of different materials and the range of applications. Introduction to rapid prototyping - Classification of rapid prototyping methods - sterolithography, fused deposition methods - materials, principle of prototyping and various applications.

UNIT – II

Electrical Energy Based Processes

Electric Discharge Machining – Working Principles, Description of Equipment, Process Parameters, Surface Finish and MRR, Electrode / Tool, Power and Control Circuits, Tool Wear, Dielectric Fluid, Flushing, Advantages, Limitations and Applications. Wire cut EDM – Working Principle and Applications.

UNIT-III

Chemical and Electro Chemical Energy Based Processes

Chemical Machining and Electro Chemical Machining – Working Principle, Description of Equipment, Etchants, Maskants, Techniques of Applying Maskants, Process Parameters, Surface Finish and MRR, Electro Chemical Grinding, Electro Chemical Honing, Applications, Advantages and Limitations.

UNIT-IV

Thermal Energy Based Processes

Laser Beam Machining and Drilling, Plasma Arc Machining, Electron Beam Machining – Working Principle, Description of Equipment, Process Parameters, Applications, Advantages and Limitations.

UNIT-V

ELECTRON BEAM MACHINING

Generation and control of electron beam for machining, theory of electron beam machining, comparison of thermal and non-thermal processes - process mechanics, parameters, applications and limitations.

LASER BEAM MACHINING

Process description, Mechanism of material removal, process parameters, capabilities and limitations, features of machining, applications and limitations

Text Books:

1. Jain V.K., Advanced Machining Processes, 1st Edition, Allied Publishers Pvt. Ltd., New Delhi, 2007.
2. Pandey P.C and Shan H.S., Modern Machining Processes, 1st Edition, McGraw Hill, New Delhi, 2007.
3. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1st Edition, Springer, 2010.

Reference Books:

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2nd Edition, World Scientific Publishers, 2003.
2. Benedict G.F., Nontraditional Manufacturing Processes, 1st Edition, CRC Press, 1987.
3. Mishra P.K., Nonconventional Manufacturing, 1st Edition, Narosa Publishing House, New Delhi, 2014.
4. McGeough J.A., Advanced Methods of Machining, 1st Edition, Springer, 1988.

<table>
<tr><th>Course Title</th><th colspan="5">Design for Manufacturing</th><th colspan="3">B.Tech ME VII Sem (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">2003702</td><td rowspan="2">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: 90 MIN</td><td colspan="3">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Explain the product development cycle and manufacturing issues to be considered in design.
- Familiarize manufacturing consideration in cast, forged, and weld components.
- Describe the manufacture of sheet metal components.
- Impart knowledge plastics as substitution to metallic parts.
- Integrate the knowledge of manufacturing and assembly method in plastics

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

CO 1	Design mechanical components with economical consideration.
CO 2	Select materials and machining processes.
CO 3	Identify the necessity for redesigning components out of manufacturing considerations.
CO 4	Consider the manufacturing considerations while designing cast, forged weld and sheet metal components.
CO 5	Integrate the knowledge of compliance analysis and interference analysis for assembly and also use visco-elastic and creep in plastics.

UNIT-I

Introduction

Design philosophy – steps in design process – general design rules for manufacturability – basic principles of designing for economical production – creativity in design, application of linear & non-linear optimization techniques.

Materials: Selection of materials for design – developments in material technology – criteria for material selection – material selection interrelationship with process selection – process selection charts.

UNIT – II

Machining processes

Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness-Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

<u>UNIT – III</u>

Metal Casting and Joining: Metal casting

Appraisal of various casting processes, selection of casting process,-general design considerations for casting-casting tolerance-use of solidification, simulation in casting design-product design rules for sand casting.

Metal joining: Appraisal of various welding processes, factors in design of weldments – general design guidelines-pre and post treatment of welds-effects of thermal stresses in weld joints-design of brazed joints.

<u>UNIT – IV</u>

Forging, Extrusion & Sheet metal work:Forging

Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

Extrusion & Sheet metal work

Design guide lines extruded sections-design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram – component design for blanking.

<u>UNIT-V</u>

Assembly: Compliance analysis and interference analysis for the design of assembly – design and development of features for automatic assembly – liaison diagrams. Environment: Introduction to environment; motivations for environment principles of environment- eco-efficiency, product life cycle perspective, environment tools and processes, environment design guidelines.

<u>Text Books:</u>

1. George E Dieter and Linda Schmidt, Engineering Design, 4th Edition, McGraw Hill (2015)
2. A.K.Chitale and R.C.Gupta, Product Design and Manufacturing, 5th Edition, PHI Learning (2011)
3. David M Anderson, Design for Manufacturability, CRC Press (2013)

<u>Reference Books</u>:

1. James G Bralla, Design For Manufacturability Handbook, 2nd Edition, McGraw Hill (2004).
2. Dr.P.C.Sharma, Production Technology, S.Chand& Company (2009).

<table>
<tr><td>Course Title</td><td colspan="5">Solar and Wind Energy Systems</td><td colspan="3">B.Tech ME 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">2003703</td><td rowspan="2">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="5">Mid Exam Duration: 90 MIN</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.
- Familiarize the wind energy sources assessment
- Explain basics of designing aerofoil

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

CO 1	Explain the basic concepts of solar radiation and solar collectors
CO 2	Develop sun path diagrams
CO 3	Explain the properties of a semiconductor
CO 4	Apply the principles of solar thermo photo voltaics
CO 5	Utilize different wind parameters for design of rotor

UNIT-I

Energy conservation and storage

Energy- Energy Sources & their Availability - Importance of Renewable Energy Resources - Principles of energy conservation- Energy storage- Necessity of energy storage-Energy storage methods- Mechanical Energy storage -Pumped storage-Compressed air storage Electrical Storage -Lead Acid Battery -Chemical Storage -Energy storage via hydrogen -Electromagnetic energy storage

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 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-photo voltaics.

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-III

Introduction to wind energy

Historical Perspectives on Wind Turbines- Indian Energy Scenario - Global Energy Scenario - Introduction to Indian Wind Industry - Wind Energy potential of India and Global Wind Installations.

Basics of Wind Resource Assessment

Power in the wind –Wind Characteristics - Measurement of wind using anemometers (cup anemometer, propeller anemometer, pressure plate anemometer, pressure tube anemometer, sonic anemometer and other remote wind speed sensing techniques) –Turbulence-Wind Power Density –Average wind speed calculation - Statistical models for wind data analysis (Weibull and Rayleigh distribution). Energy estimation of wind regimes – Wind Rose, Wind Monitoring Station Siting and Instrumentation

UNIT-IV

Wind Energy Conversion Systems

Types - Components of Modern Wind Turbine (HAWT and VAWT) - Fixed and Variable Speed operations - Power Control (Passive stall, Active pitch, Passive pitch and Active stall) - Electrical aspects of wind turbine, Safety of wind turbines.

UNIT-V

Wind Farm Design and Health (Condition) Monitoring

Planning of wind farm, Site selection, Micro siting, Grid Integration, Power evacuation, Wind Farm Feasibility Studies, Preparation of DPR, Environmental Benefits and Impacts. Water pumping wind mills, offshore wind energy, Wind turbine testing, future developments.

Text Books:

1. Goswami D.Y., Kreider, J. F. and Francis., "Principles of Solar Engineering', Taylor and Francis, 2000.
2. Chetan Singh Solanki, "Solar Photo voltatics – Fundamentals, Technologies and Applications", PHI Learning Private limited, 2011.

Reference Books:

1. Sukhatme S.P.,.Nayak.J.P, 'Solar Energy – Principle of Thermal Storage and collection", Tata McGraw Hill, 2008.
2. Sathyajith Mathew, Wind Energy Fundamentals, Resource Analysis and Economics, Springer Publications, (2006).
3. Wei Tong, Wind Power Generation and Wind Turbine Design, WIT Press, (2010.
4. Wind Power, Revised Edition: Renewable Energy for Home, Farm, and Business, Paul Gipe, 2004, Chelsea Green Publishing.
5. A. R. Jha, Wind Turbine Technology, CRC Press, (2010).

<table>
<tr><th>Course Title</th><th colspan="4">Mechanical Behavior of Materials</th><th colspan="3">B.Tech ME VII Sem (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">2003704</td><td rowspan="2">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>
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<tr><td colspan="5">Mid Exam Duration: 90 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Explain the structure of material over the effects of mechanical properties.
- Familiarize the defects inside the structure and their effects on the mechanical properties.
- Train the methods for characterization of the mechanical behaviour of materials.
- Impart knowledge about strengthening mechanisms of materials.
- Teach mechanisms of failures of materials (fracture, fatigue and creep) and their relationship with the different types of stress.

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

CO 1	Determine dislocation reaction, cross slip and climb of dislocations.
CO 2	Characterize materials using different machines.
CO 3	Summarize the various strengthening mechanisms with suitable examples
CO 4	Identify the creep in different materials and its influence in selection of materials.
CO 5	Predict the metallurgical factors affecting creep. e Demonstrate various creep testing machines.

UNIT-I

Dislocation

Dislocation Theory: Introduction, dislocation reaction, cross slip and climb of dislocations, dislocation sources and dislocation multiplication, dislocation pile ups. Tensile Behaviours of Metals:

Elastic and plastic behaviour: Elastic behaviour of materials – Hooke's law, plastic behavior: dislocation theory – Burger's vectors and dislocation loops, dislocations in FCC, HCP and BCC lattice, stress fields and energies of dislocations, forces on and between dislocations, slip and twinning.

UNIT – II

Strengthening mechanisms

Cold Working, Grain Size Strengthening, Solid Solution Strengthening, Martensitic Strengthening, Precipitation Strengthening, Dispersion Strengthening, Fibre Strengthening, Examples. Yield Point Phenomenon, Strain aging and Dynamic strain aging.

UNIT – III

Fracture and fracture mechanics

Fracture and fracture mechanics: Types of Fracture, Basic Mechanism of Ductile and Brittle Fracture, Griffith's Theory Of Brittle Fracture, Ductile to Brittle Transition Temperature (DBTT), Factors Affecting DBTT, Determination of DBTT. Fracture Mechanics-Introduction, Modes of Fracture, Stress Intensity Factor, Strain Energy Release Rate, Fracture Toughness and Determination of K_{IC}.

UNIT – IV

Fatigue behaviour and testing

Stress Cycles, S-N Curves, Effect of Mean Stress, Factors Affecting Fatigue, Structural Changes Accompanying Fatigue, Cumulative Damage, HCF / LCF, Thermo-mechanical Fatigue, Application of Fracture Mechanics to Fatigue Crack Propagation, Fatigue Testing Machines

UNIT-V

Mechanical testing of materials

destructive testing, hardness testing, tensile testing, compression, bending, impact, torsion, creep and fatigue testing procedures. nondestructive testing, die-penetration test, ultrasonic tests, X-ray test, magnetic particles test eddy current testing.

Text Books:

1. Dieter, G.E., "Mechanical Metallurgy", McGraw-Hill, SI Edition, 1995.

2. Davis. H. E., Troxell G.E., Hauck.G. E. W., "The Testing Of Engineering Materials", McGraw-Hill, 1982.

Reference Books:

1. Wulff, The Structure and Properties of Materials, Vol. III "Mechanical Behavior of Materials", John Wiley and Sons, 1983.

2. Honey Combe R. W. K., "Plastic Deformation of Materials", Edward Arnold Publishers, 1984.

3. Suryanarayana, A. V. K., "Testing of Metallic Materials", Prentice Hall India, 1979.

<table>
<tr><td>Course Title</td><td colspan="4">Total Quality Management</td><td colspan="3">B.Tech ME 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">2003705</td><td rowspan="2">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="5">Mid Exam Duration: 90 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Introduce the students, the basic concepts of Total Quality Management.
- Expose with various quality issues in Inspection.
- Gain Knowledge on quality control and its applications to real time.
- Know the extent of customer satisfaction by the application of various quality concepts. Understand the importance of Quality standards in Production.

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

CO 1	Develop an understanding on quality Management philosophies and frameworks
CO 2	Adopt TQM methodologies for continuous improvement of quality
CO 3	Measure the cost of poor quality, process effectiveness and efficiency to identify areas for improvement.
CO 4	Apply benchmarking and business process reengineering to improve management processes.
CO 5	Determine the set of indications to evaluate performance excellence of an organization.

UNIT-I

Introduction to quality management

Definitions – TOM framework, benefits, awareness and obstacles. Quality – vision, mission and policy statements. Customer Focus – customer perception of quality, Translating needs into requirements, customer retention. Dimensions of product and service quality. Cost of quality.

UNIT-II

Historical Review

Quality council, Quality statements, Strategic Planning, Deming Philosophy, Barriers of TQM Implementation, Benefits of TQM, Characteristics of successful quality leader, Contributions of Gurus of TQM, Case studies

UNIT-III

TQM Principles

Customer Satisfaction – Customer Perception of Quality, Customer Complaints, Service Quality, Customer Retention, Employee Involvement – Motivation, Empowerment teams, Continuous Process Improvement – Juran Trilogy, PDSA Cycle, Kaizen, Supplier Partnership – Partnering, sourcing, Supplier Selection, Supplier Rating, Relationship Development, Performance Measures – Basic Concepts, Strategy, Performance Measure Case studies.

UNIT-IV

TQM Tools

Benchmarking – Reasons to Benchmark, Benchmarking Process, Quality Function Deployment (QFD) – House of Quality, QFD Process, Benefits, Taguchi Quality Loss Function, Total Productive Maintenance (TPM) – Concept, Improvement Needs, FMEA – Stages of FMEA, The seven tools of quality, Process capability, Concept of Six Sigma, New Seven management tools, Case studie

UNIT-V

Quality Systems Organizing And Implementation

Introduction to IS/ISO 9004:2000 – quality management systems – guidelines for performance improvements.Quality Audits.TQM culture, Leadership – quality council, employee involvement, motivation, empowerment, recognition and reward- Introduction to software quality**.**

Text Books:

1. Dale H Besterfield, Total Quality Management, Fourth Edition, Pearson Education, 2015.
2. SubburajRamaswamy, Total Quality Management, Tata Mcgraw Hill Publishing Company Ltd., 2005.
3. Joel E.Ross , Total Quality Management, Third Eition, CRC Press, 2017.

Reference Books:

1. Narayana V and Sreenivasan N.S, Quality Management – Concepts and Tasks, New Age International, 1996.
2. Robert L.Flood, Beyond TQM, First Edition, John Wiley & Sons Ltd, 1993.
3. Richard S. Leavenworth & Eugene Lodewick Grant, Statistical Quality Control, Seventh Edition, Tata Mcgraw Hill, 2015
4. Samuel Ho , TQM – An Integrated Approach, Kogan Page Ltd, USA, 1995.

<table>
<tr><th>Course Title</th><th colspan="4">Automobile Engineering</th><th colspan="3">B.Tech ME VII Sem (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">2003706</td><td rowspan="2">PEC-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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Impart the knowledge of vehicle structure and its components.
- Demonstrate various components of petrol engines and diesel engines.
- Trains about the various electrical system, circuits, and testing of automobiles.
- Explain the concepts of steering, suspension and braking system in automobile.
- The functioning of the engine and its accessories, gear box, clutch,brakes, steering, axles and wheels.

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

CO 1	Identify different parts of automobile.
CO 2	Explain the working of various parts like engine and brakes.
CO 3	Describe the working of steering and the suspension systems.
CO 4	Summarize the wheels and tires.
CO 5	Outline the future developments in the automobile industry.

UNIT-I

Introduction: Components of a Four Wheeler Automobile - Chassis and Body - Power Unit Power Transmission - Rear Wheel Drive, Front Wheel Drive, Four Wheel Drive - Types of Automobile Engines, Engine Construction, Turbo Charging and Super Charging - Oil Filters, Oil Pumps - Crank Case Ventilation.

UNIT-II

Ignition and fuel supply

Ignition system - Coil and Magneto - Spark plug - Distributor – Electronic ignition system - Fuel system - Carburetor - Fuel pumps - Fuel injection systems - Mono point and Multi point – Unit Injector – Nozzle types - Electronic Fuel Injection system (EFI) – GDI, MPFI, DTSI.

UNIT-III

Steering and suspension system

Principle of steering - Steering Geometry and wheel alignment - Steering linkages – Steering gearboxes - Power steering - front axle - Suspension system - Independent and Solid axle – coil, leaf spring and air suspensions - torsion bar - shock absorbers.

UNIT-IV

Wheels, Tires and Braking System

Wheels and Tires - Construction - Type and specification - Tire wear and causes - Brakes - Needs – Classification –Drum and Disc Mechanical - Hydraulic and pneumatic - Vacuum assist – Retarders – Anti-lock Braking System(ABS)

UNIT-V

Emissions From Automobiles

Pollution Standards National and International Pollution Control- Techniques - Multipoint Fuel Injection for Sl Engines- Common Rail Diesel Injection, Emissions from Alternative Energy Sources- Hydrogen, Biomass, Alcohols, LPG, CNG - Their Merits And Demerits.

Electrical System: Charging Circuit, Generator, Current - Voltage Regulator - Starting System, BendixDrive, Mechanism of Solenoid Switch, Lighting Systems, Horn, Wiper, Fuel Gauge - Oil Pressure Gauge, Engine Temperature Indicator.

Text Books:

1. Kirpal Singh, Automobile Engineering, Vol.1&2, Standard Publications year.

2. William.H.Crouse, Automotive Mechanics, 10/e Edition, McGraw-Hill, (2006).

3. David A. Corolla, Automotive Engineering: Powertrain, Chassis System and Vehicle Body,

Butterworth-Heinemann Publishing Ltd, (2009).

4. Richard Stone, Jeffrey K. Ball, Automotive Engineering Fundamentals" SAE International (2004).

Reference Books:

1. Bosch, Automotive Hand Book, (2007), 6/e SAE Publications year.

2. K. Newton and W. Steeds, The motor vehicle, 13/e Butterworth-Heinemann Publishing Ltd. (year).

3. Joseph Heitner, Automotive Mechanics Principles and Practices, 2/e, CBS publishing 2004.

<table>
<tr><td>Course Title</td><td colspan="5">Additive Manufacturing</td><td colspan="3">B.Tech ME 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">2003707</td><td rowspan="2">PEC-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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives:
● Familiarize of additive manufacturing / rapid prototyping and its applications in various fields.
● Impart reverse engineering techniques.
● Explain different processes available in additive manufacturing.
● Bring awareness on mechanical properties of materials and geometric issues related to additive manufacturing applications.
● To create physical objects that facilitates product development/prototyping requirements.</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 various additive manufacturing and rapid prototyping techniques applications.</td></tr>
<tr><td>CO 2</td><td colspan="8">Describe different additive manufacturing processes.</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply methods in rapid prototyping.</td></tr>
<tr><td>CO 4</td><td colspan="8">Use powder based AM system.</td></tr>
<tr><td>CO 5</td><td colspan="8">Model 3D printing using SDM and BPM methods.</td></tr>
</table>

UNIT-I

INTRODUCTION:

Introduction to layered manufacturing, Importance of Additive Manufacturing Additive Manufacturing in Product Development Classification of additive manufacturing processes, Common additive manufacturing technologies; Fused Deposition Modeling(FDM), Selective Laser Sintering(SLS), Stereo Lithography(SLA), Selection Laser Melting (SLM), Jetting, 3D Printing, Laser Engineering Net Shaping (LENS), Laminated Object Manufacturing (LOM), Electron Beam Melting (EBM) Capabilities, materials, costs, advantages and limitations of different systems.

UNIT-II

CAD & Reverse Engineering:

Basic Concept, Digitization techniques, Model Reconstruction, Data Processing for Additive Manufacturing Technology: CAD model preparation, Part Orientation and support generation, Model Slicing, Tool path Generation, Software's for Additive Manufacturing Technology: MIMICS, MAGICS. Reverse Engineering (RE) –Meaning, Use, RE – The

Generic Process, Phase of RE Scanning, Contact Scanners, Noncontact Scanners, Point Processing, Application Geometric Model, Development.

UNIT-III

Solid and Liquid Based AM 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-IV

Powder Based AM 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.

UNIT-V

RP Applications:

Application – Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Jewelry Industry, Coin Industry, GIS application, Arts and Architecture. RP Medical and Bioengineering Applications: Planning and simulation of complex surgery, Customized Implants & Prosthesis, Design and Production of Medical Devices, Forensic Science and Anthropology, Visualization of Biomolecules.

Text Books:

1. Ian Gibson, David W. Rosen, Brent Stucker, Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing, 1/e Springer, 2010.
2. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 2/e World Scientific Publishers, 2003.
3. Liou W. Liou, Frank W., Liou, Rapid Prototyping and Engineering Applications: A Tool Box for Prototype Development, CRC Press, 2007.

Reference Books:

1. Pham D.T. and Dimov S.S., Rapid Manufacturing; The Technologies and Application of RPT and Rapid Tooling, Springer, London 2001.
2. Gebhardt A., Rapid prototyping, Hanser Gardener Publications, 2003.
3. Hilton P.D. and Jacobs P.F., Rapid Tooling: Technologies and Industrial Applications, CRC Press, 2005.
4. RafiqNoorani, Rapid Prototyping: Principles and Applications in Manufacturing, John Wiley & Sons, 2006.

<table>
<tr><th>Course Title</th><th colspan="4">Mechanical Vibrations</th><th colspan="3">B.Tech ME VII Sem (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><th rowspan="2">2003708</th><th rowspan="2">PEC-IV</th><th>L</th><th>T</th><th>P</th><th>C</th><th>Continuous Internal Assessment</th><th>End Exam</th><th>Total</th></tr>
<tr><th>3</th><th>0</th><th>0</th><th>3</th><th>40</th><th>60</th><th>100</th></tr>
<tr><th colspan="5">Mid Exam Duration: 90 MIN</th><th colspan="4">End Exam Duration: 3Hrs</th></tr>
</table>

Course Objectives:

- Demonstrate basic concepts and definitions of mechanical vibrations. To write equation of motion for discrete spring-mass systems with different configuration using classical and energy methods.
- To train the students about basic concepts of forced vibrations, vibration transmissibility and isolation and seismic instruments. Further to understand about various vibration control methods.
- To familiarize the students about two degree freedom system and various types of vibration absorbers.
- To analyze the two degree and multi degree of freedom systems.
- Determine the numerical methods to determine natural frequencies ofthe beam and rotor systems.

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

CO 1	Find natural frequency of un-damped single degree freedom systems
CO 2	Analyze the two degree freedom systems with and without damping.
CO 3	Calculate transmissibility and isolation.
CO 4	Solve problems on vibration absorber.
CO 5	Calculate natural frequencies of multi degree freedom system.

UNIT-I

Transverse vibrations

single concentrated load, uniformly distributed load, several loads, Dunkerley‘s method, energy method, whirling of shafts. Torsional vibrations – single rotor, two-rotor, three-rotor systems, torsionally equivalent shaft, geared system.

UNIT-II

Forced vibrations of Single Degree Freedom Systems

Steady state forced vibration, sources of excitation, impressed harmonic force, resonance impressed force due to unbalance, motion excitation, transmissibility and isolation, performance of different type of isolators, power absorbed by viscous damping.

UNIT-III

Two Degree Freedom Systems

Formulation of Equation of motion, Natural frequencies and modes of vibration by classical method, coupled pendulum, forced vibration, dynamic vibration absorber.

UNIT-IV

Multi Degree Freedom Systems

Lagrangian method for formulation of equation of motion Influence co- efficient method, Lumped mass and distributed mass systems, Stodola method, Holzer's method, model analysis of free and forced vibrations.

UNIT – V

Continuous systems

vibration of strings – longitudinal vibrations of bars – torsional vibrations of circular shafts - lateral vibration of beams Critical speeds of shafts – Critical speed of a light shaft having a single disc – without damping and with damping. Critical speed of a shaft having multiple discs – secondary critical speed

Text Books:

1. Singrasu S. Rao, Mechanical Vibrations, 6/e, Pearson Education, 2018.
2. G.K.Groover, Mechanical Vibrations, 8/e, 2009

Reference Books:

1. L. Meirovich, Elements of Vibrations Analysis, Tata McGraw Hill, 1986
2. S. Graham Kelly, Mechanical Vibrations, Tata McGraw Hill, 1996
3. William Thomson, Theory of Vibrations with Applications, 5/e, Pearson, 2008
4. William Weaver, Timeoshenko, and Young, Vibration Problems in Engineering, 5/e, John Wiley, 2013.
5. C. Nataraj, Vibration of Mechanical Systems, 1/e, Cenage Learning, 2012.

<table>
<tr><td>Course Title</td><td colspan="5">Material Characterization</td><td colspan="3">B.Tech ME 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">2003709</td><td rowspan="2">PEC-IV</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>
</table>

Course Objectives:

- Familiarize the fundamentals in material characterization.
- Explain principles in X-ray diffraction and Stereographic projections.
- Describe the fundamental principles of characterization.
- Evaluate the uncertainty of observations and results from the different methods.
- Impart the methods of characterization for different material problems.

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

CO 1	Explain the production of characteristic x-rays.
CO 2	Use the principles of diffraction (Bragg's Law) in determination of crystal structure determination.
CO 3	Interpret the properties of electrons and the affect of accelerating potential.
CO 4	Apply basic operational modes of a SEM and TEM.
CO 5	Explain the formation of diffraction patterns in the electron microscopes.

UNIT-I

Diffraction Methods: Fundamental crystallography, Generation and detection of X-rays, Diffraction of X-rays, X-ray diffraction techniques, Electron diffraction.

Spectroscopy: Atomic absorption spectroscopy, UV/Visible spectroscopy, Fourier transform infrared spectroscopy, Raman spectroscopy.

UNIT-II

Diffraction and Imaging: Phenomena of diffraction; Radiation-matter Interactions and response signals; X-ray diffraction: powder diffraction, phase identification, Scherrer formula, strain and grain size determination; Fundamentals of Imaging: magnification, resolution, depth of field and depth of focus aberration and astigmatism; X-Ray reflectivity

UNIT-III

Optical microscopic Techniques: Special microscopy techniques and applications: Bright field and dark field imaging; confocal microscopy; interference microscopy; polarized light microscopy; phase contrast microscopy. Scanning near field laser microscopy; Image processing and quantification.

Optical Spectroscopic Techniques - Principle, Working and Result Analysis of Fourier Transformation Infra-Red Spectroscopy; Raman Spectroscopy; UV-Vis Absorption Spectroscopy; Photoluminescence Spectroscopy - Ellipsometer Spectroscopy.

UNIT-IV

Electron Microscopic Techniques: Basics of Electron Microscopy - Introduction - Principle of SEM, Instrumentation, Contrast formation, Operational variables, Specimen preparation, imaging modes, Applications, Limitations – FE-SEM , FIB, EDAX. TEM - Introduction, Instrumentation, Specimen preparation: Mechanical thinning, electrochemical thinning, ion milling, sputter coating and carbon coating, replica methods. Image modes - mass density contrast, diffraction contrast, phase contrast, Applications, Limitations.

UNIT-V

Surface Analysis: Atomic force microscopy, scanning tunneling microscopy, X-ray photoelectron spectroscopy.

Thermal analysis: Instrumentation, experimental parameters, Differential thermal analysis, Differential Scanning Calorimetry, Thermogravimetry, Dilatometry, Dynamic mechanical analysis- Basic principles, Instrumentation, working principles, Applications, Limitations.

Text Books:

1. Yang Leng, Materials Characterization: Introduction to Microscopic and Spectroscopic Methods, 2/e, Wiley Publications, 2013.

Reference Books:

1. D. Brandon and W.D. Kaplan, Microstructural Characterization of Materials, John Wiley and Sons, 2008.

2. S. Zhang, Lin Li and Ashok Kumar, Materials Characterisation Techniques, CRC Press, 2009.

3. B.D.Williams and C.B.Carter, Transmission Electron Microscopy –Springer, 2009.

4. E.J. Mittemeijer, Fundamentals of Materials Science - the microstructure-property relationship using metals as model systems, Springer, 2010

<table>
<tr><td>Course Title</td><td colspan="4">Production and Operations Management</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">2003710</td><td rowspan="2">PEC-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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Introduction to the technical design and manufacturing operations and supply management to the sustainability of an enterprise.
- Need for forecasting and types of forecasting.
- Import the basic principles of project management and other business functions such as value engineering, purchasing, marketing, finance etc.
- Analyze the new demands of the globally competitive business environment that supply chain managers face today.
- Knowledge on various scheduling algorithms applicable to single machine, parallel machines, flow shop and job shop models.

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

CO 1	Demonstrate the operations and supply management to the sustainability of an enterprise.
CO 2	Identify the need for forecasting and understand different forecasting methods.
CO 3	Identify various production and plant layouts.
CO 4	Examine the quality control of the production.
CO 5	Apply Just in Time (JIT) basic principles and applications.

UNIT-I

Introduction

Nature and Scope of Production/Operations Management, POM Relationship with other Systems in the Organisation, Factors that affect System and Concept of Production and Operation Management. Facility Location, Types of Manufacturing Systems, Lean Manufacturing, Student Planning and Analysis**.**

UNIT-II

Forecasting

Introduction, Statistical Forecasting Techniques, Moving Average, Exponential Smoothing Technique, Errors in Forecasting and Evaluation of Forecasting Techniques.

UNIT-III

Value Engineering and Plant Layout

Value Engineering – Objectives, Types of Values, Function and Cost, Product Life Cycle, Steps in Value Engineering, Methodology in Value Engineering, FAST Diagram and Matrix Method. Facility Location and Layout – Factor Considerations in Plant Location, Comparative Study of Rural and Urban Sites, Methods of Selection of Plant Layout, Objectives of Good layout, Principles, Types of Layout, Line Balancing

UNIT-IV

Aggregate Planning and MRP

Aggregate Planning – Definition, Different Strategies, Various Models of Aggregate Planning- Transportation and Graphical Models, Master scheduling, Material Requirement Planning(MRP)- Terminology, Types of Demands, Inputs to MRP, Techniques of MRP, Lot Sizing Methods, Benefits and Drawbacks of MRP, Manufacturing Resources Planning (MRP II), Just in Time (JIT) Philosophy, Kanban System, Calculation of Number of Kanbans, Pull Systems vs. Push Systems, Requirements for Implementation of JIT, JIT Production Process, Benefits of JIT.

UNIT-V

Quality in Production & Operations Management

Quality Assurance, Accepting Sampling, Statistical Process Control, Total Quality Management,

QMS and ISO Standards.

Text Books:

1. Buffa E.S. and Sarin R.K., Modern Production / Operations Management, 8th Edition, Wiley India Pvt. Ltd., New Delhi, 2009.

2. Joseph G. Monks, Operations Management-Theory and Problems, 3rd Edition, McGraw Hill Education, 1987.

Reference Books:

1. James L. Riggs, Jim Rigs, Production Systems: Planning, Analysis and Control, 4th Edition, Wave Land Press, 1992.

2. Chary S.N., Production and Operations Management, 5th Edition, McGraw Hill Education, 2017.

3. Richard B.Chase, Ravi Shankar, Robert Jacobs F., Operations and Supply Chain Management, 15th Edition, McGraw Hill Education, 2018.

4. Pannerselvam R., Production and Operations Management, 3rd Edition, PHI Learning Pvt. Ltd., New Delhi, 2012.

5. Steven Nahmias, Tava Lennon Olsen, Production and Operation Analysis: Strategy – Quality – Analytics – Applications, 7th Edition, Waveland Press Inc., 2015.

<table>
<tr><td>Course Title</td><td colspan="4">Vehicle Diagnosis and Control</td><td colspan="3">B.Tech ME 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">2003711</td><td rowspan="2">PEC- V</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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Introduce various techniques in Vehicle Diagnosis.
- Familiarize sensors and actuators associated with Oscilloscope Diagnostics.
- Identify various faults in the engine system.
- Discuss the concepts of engine system and vehicle systems diagnosis.
- To provide knowledge on, diagnostic procedure and instrumentation.

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

CO 1	Perform vehicle diagnosis and apply the fault finding techniques practically.
CO 2	Understand the basic concepts of On board and off board diagnosis
CO 3	Recall the concepts of Exhaust, Cooling and Lubrication systems.
CO 4	List various faults in the electrical system diagnosis
CO 5	Summarize the principles of traction control system diagnosis and transmission system diagnosis.

UNIT-I

INTRODUCTION

Diagnostic process, Mechanical techniques, Electrical techniques, Fault codes, Datasources, Basic equipments, Piecoscope oscilloscope, Scanners, Emission testing, pressure testing, Automotive pressure oscilloscope transducer.

UNIT – II

On and off Board Diagnostics

Introduction to oscilloscope Diagnostics. Sensors And Actuators Associated With Oscilloscope Diagnostics. On-Board Diagnostics Various Perspectives.Petrol/Gasoline On-Board Diagnostics. On-Board Sensors And Actuators. Sensors And Actuators Comparative Case Study.

UNIT-III

Engine System Diagnosis

Introduction Engine Systems Diagnostics. Engine Operation And Fuel System. Ignition System And Emission System. Fuel Injection, Starting And Charging System. Power Flow

Control And Energy Efficiency Analysis. Engine Management and Fault finding Information. Air Supply, Exhaust System, Cooling and Lubrication System.

UNIT – IV

Chassis and Brake System Diagnosis: Introduction to Vehicle System Diagnostics, Anti-Lock Braking System Diagnostics. Traction Control System Diagnostics, Steering And Tires. Transmission Systems Diagnostics

UNIT – V

Electrical And Electronic Systems

Diagnosis of Electronic components and circuits, Multiplexing, Diagnosis of lighting and electrical system and components, Instruments, Auxiliaries**.**Diagnosis of Electronic components and circuits, Multiplexing, Diagnosis of lighting and electrical system and components, Instruments, Auxiliaries.

Text Books:

1. Richard.C.Dorf and Robert.H.Bishop , "Modern Control System" 12th edition Pearson Prentice Hall,2013.

2. Benjamin.C.Kuo, "Automatic control systems", Prentice Hall of India, 7th Edition, 1995.

3. Tom denton "Advanced automotive fault diagnosis", Elsevier butterworth-heinemannlinacre house, jordan hill, oxford ox2 8dp, uk - isbn-10: 0-75-066991-8.

4. Tom Denton "Automotive Electronics Handbook", - - McGraw-Hill Publishing Co.; 2nd Revised edition 1999, ISBN10:0070344531

Reference Books:

1. J.Nagrath and M.Gopal, "Control System Engineering", New Age International Publishers, 5th Edition, 2007.

2. Routledge "Automobile Electrical and Electronic Systems", 4th edition 2012, ISBN10: 0080969429.

Course Title	Mechatronics & MEMS					B.Tech ME VII Sem (R20)		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003712	**PEC- V**	**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:

- Familiarize the technologies behind modern mechatronic systems.
- Explain fundamentals for the development of fully automated system.
- Develop a robotic or automated systems focusing on the hardware and software integration.
- Demonstrate the development of mechatronic system and MEMS.
- To study the various sensors and actuators, applications of MEMS.

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

CO 1	Demonstrate the knowledge of MEMS.
CO 2	Classifying different fabrication techniques of MEMS.
CO 3	Illustrate the application of MEMS in industry.
CO 4	Describe the techniques are of used to design a mechatronics process.
CO 5	Suggest possible design solutions.

UNIT-I

Introduction

Definition of Mechatronics, Mechatronics in manufacturing, Products, and design.Comparison between Traditional and Mechatronics approach.Computer numerical control (CNC) machines, Tool monitoring systems, Flexible manufacturing system (FMS), Industrial Robots, Automatic packaging systems, Automatic inspection systems.

UNIT-II

Sensors

Static characteristics of sensors, Displacement, Position and Proximity sensors, Force and torque sensors, Pressure sensors, Flow sensors, Temperature sensors, Acceleration sensors, Level sensors, Light sensors, Smart material sensors, Micro and Nano sensors, Selection criteria for sensors.

UNIT-III

Actuators

Mechanical, Electrical, Hydraulic and Pneumatic Actuation systems, Characteristics and their limitations, Design of Hydraulic and Pneumatic circuits, Piezoelectric actuators, Shape memory alloys, Selection criteria for actuators.

UNIT-IV

Microprocessors, Microcontrollers and Programmable Logic Controllers

Architecture of Microprocessor, Microcontroller and Programmable Logic Controller, PLC Programming using ladder diagrams, logics, latching, sequencing, timers relays and counters, data handling, Analog input/output, selection of controllers.

UNIT-V

Hydraulic systems

flow, pressure and direction control valves, actuators, and supporting elements, hydraulic power packs, pumps. Design of hydraulic circuits. Pneumatics: production, distribution and conditioning of compressed air, system components and graphic representations, design of systems, Description.

Text Books:

1. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering ,WBolton, 3/e Pearson Education Press, 2005.

2. DevadasShetty and Richard A Kolk, Mechatronic System Design, 2/e, Cengage learning, 2010.

Reference Books:

1. Clarence W. de Silva, Mechatronics an Integrated Approach, CRC Press, 2004.

2. James J Allen, Micro Electro Mechanical Systems Design, CRC Press Taylor & Francis group, 2005.

3. Ganesh S Hedge, Mechatronics, Jones & Bartlett Learning, 2010.

Course Title	**Design of Oil Hydraulics and Pneumatics**					**B.Tech ME VII Sem (R20)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
2003713	**PEC- V**	**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:

- Familiarize on Fluid Power Engineering and Power Transmission System.
- Introduce the students, the basic concepts of hydraulic and pneumatic systems.
- Expose the students with various hydraulic and pneumatic actuators.
- Familiarize on fluid power systems and its applications to real time.
- Know the problem, which occur in fluid power systems and take necessary troubleshooting/ maintenance activities.
- Get practiced in designing hydraulic and pneumatic systems.

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

CO 1	Compare the differences between hydraulic and pneumatic systems.
CO 2	Identify the practical applications in automation.
CO 3	Build the circuits for a given applications.
CO 4	Develop hydraulic and pneumatic power packs.
CO 5	Discuss the importance of PLC and microprocessor in hydraulic and pneumatic systems.

UNIIT-I

Introduction to Hydraulics

Fluid- Concept and classification of fluid-Newton's law viscosity-Properties of fluidDensity, Specific gravity, Specific Weight, Specific Volume- Dynamic Viscosity, Kinematic Viscosity, Surface tension, Capillarity, Vapour Pressure, Compressibility-Fluid pressure, Pressure head, Pressure intensity-Concept of absolute vacuum, gauge pressure, atmospheric Pressure-pressure,- Simple and differential manometers, Bourdon pressure gauge**.**

UNIT-II

Oil Hydraulic Pumps, Actuators

Types of hydraulic pumps - construction and working principle - design considerations, selection, specifications and characteristics of pumps. Types of actuators-construction and working principle - design considerations, selection, specifications and characteristics of actuators.

Control And Regulation Elements: Direction control valves, Pressure control valves, Flow control valves, Non-return valves, Reservoirs, Accumulators, Heating & cooling devices, Hoses. Selection of valves for hydraulic circuits.

UNIT-III

Design Of Hydraulic Circuits

Speed control circuits - Regenerative circuits- Accumulators and Intensifiers: Types of accumulators – Accumulators circuits, sizing of accumulators, intensifier – Applications of Intensifier–Intensifier circuit. - Reservoir design - Selection of components. Hydraulic circuits - Reciprocating - Quick return - Sequencing synchronizing - Safety circuits - Industrial circuits - Press - Milling Machine - Planner - Fork Lift.

UNIT-IV

Pneumatic Systems

Pneumatic fundamentals - Properties of air – Compressors – Filter, Regulator, and Lubricator unit – Air control valves, Quick exhaust valves, and pneumatic actuators. Control Elements - Logic Circuits -Position - Pressure Sensing - Switching – Electro Pneumatic - Electro Hydraulic Circuits - Robotic Circuits.

UNIT-V

Design Of Pneumatic Circuits

Classic-Cascade-Step counter - Combination -Methods - PLC-Microprocessors -Uses - Selection criteria for Pneumatic components - Installation and Maintenance of Hydraulic and Pneumatic power packs - Fault finding - Principles of Low Cost Automation - Case studies

Text Books:

1. Anthony Esposito, “Fluid Power with Applications”, Pearson Education 2000.
2. Majumdar S.R, “Oil Hydraulics”, Tata McGraw Hill, 2000.
3. Majumdar S.R, “Pneumatic Systems – Principles and Maintenance”, Tata McGraw Hill, 2001.
4. Dudelyt, A. Pease and John T. Pippenger, “Basic Fluid Power”, Prentice Hall, 1987.

Reference Books:

1. Andrew Parr, Hydraulic & Pneumatics, 2/e, Jaico Publishing House Elsevier, 1999.
2. Harry L. Stevart D.B, “Practical Guide to Fluid Power”, Taraoeala Sons and Port Ltd. Broadey, 1976.

<table>
<tr><th>Course Title</th><th colspan="4">Refrigeration & Air Conditioning</th><th colspan="3">B.Tech ME VII Sem (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">2003714</td><td rowspan="2">PEC- V</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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Provides insights in how thermodynamic principles are applied within the refrigeration and air conditioning industry.
- Introduce the students how real systems used in commercial, industrial refrigeration and air conditioning industries are built-up.
- Expose the students on various refrigeration methods like VCR, VAR and latest developments.
- Know the various air conditioning methods like summer, winter and year round air conditioning and to make the student to understand the practical applications of refrigeration and air conditioning systems.
- Understand the basic air conditioning processes on psychometric charts, calculatecooling load for its applications in comfort and industrial air conditioning.

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

CO 1	Appraise the importance of humidifiers and dehumidifiers.
CO 2	Select the requirements of temperature and humidity for human comfort.
CO 3	Demonstrate the heat pump working and its components.
CO 4	List the various air conditioning equipments.
CO 5	Present the properties, applications and environmental issues of different refrigerants

UNIT-I

Introduction to Air refrigeration system

Refrigeration machine, heat pump, coefficient of performance, ideal refrigeration cycle, Bell – Coleman, refrigeration cycle, open and closed systems, application of air- refrigeration in air-crafts

Special refrigeration system

absorption, cascade, vortex, thermoelectric and steam jet refrigeration system

UNIT-II

Vapour Compression Refrigeration (VCR) System

Vapour Compression Refrigeration (VCR) System - Basic Cycle - Working Principle and Essential Components of the Plant - COP - Representation of Cycle On T-S and P-h Charts - Expander Vs. Throttling, Effect of Sub Cooling and Super Heating - Cycle Analysis - Actual Cycle- Influence of Various Parameters on System Performance - Construction and Use of P-h Charts - Numerical Problems. Refrigerants - Desirable Properties.

UNIT-III

Vapor Absorption Refrigeration (VAR) System

Vapor Absorption Refrigeration (VAR) System- Description and Working of NH_3 - Water System and Li Br -Water (Two Shell & Four Shell) System -Calculation of Max COP, Principle of Operation of Three Fluid Absorption System

STEAM JET REFRIGERATION SYSTEM: Working Principle and Basic Components- Estimation of Motive Steam Required Principle and Operation of: (I) Thermo-Electric Refrigerator (ii) Vortex Tube or Hilsch Tube.

UNIT-IV

Introduction to Air Conditioning

Psychrometric Properties & Processes - Characterization of Sensible and Latent Heat Loads - Need For Ventilation, Consideration of Infiltrated Air - Heat Load Concepts. Air Cooler (Evaporative Cooling) ,Window, Split, Summer , Winter, Year Round, Central Air Conditioning Systems.

UNIT-V

Air Conditioning Equipment

Air Conditioning Equipment - Humidifiers - Dehumidifiers - Air Filters, Fans and Blowers. Human Comfort: Requirements of Temperature, Humidity And Concept of Effective Temperature, Comfort Chart. Heat Pump - Heat Sources - Different Heat Pump Circuits.

Text Books:

1. Refrigeration and Air Conditioning ,CPArora,TMH, 15th edition, 2013.
2. A Course in Refrigeration and Air conditioning,S.CArora&Domkundwar, Dhanpatrai

Reference Books:

1. Refrigeration and Air Conditioning / Manohar Prasad / New Age, 2nd edition, 2013
2. Principles of Refrigeration - Dossat / Pearson Education, 4th edition, 2007
3. Refrigeration and Air Conditioning-P.L.Ballaney, 2nd edition, 2012.
4. Basic Refrigeration and Air-Conditioning - P.N.Ananthanarayanan / TMH, 4th edition, 2013.

<table>
<tr><td>Course Title</td><td colspan="4">Geometric Dimension and Tolerances</td><td colspan="3">B.Tech ME 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">2003715</td><td rowspan="2">PEC- V</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 MIN</td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives:

- Teach the basics of the geometric dimensioning and tolerances.
- Familiar with five groups of GD&T tolerances, form, orientation, location, runout and profile tolerances.
- Introduce tolerances of profiles of lines and surfaces with or without datums.
- Expose the students to various surface roughness parameters and their measurements in two dimensions.
- Understand the concepts of dimensional chains and inspection techniques

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

CO 1	Contrast between conventional and GD&T tolerance zones.
CO 2	Explain MMC, LMC and RFS concepts.
CO 3	Explain Taylor's principle of gauging.
CO 4	Assess the significance of selection of datum & datum features.
CO 5	Point out form, orientation, profile, runout and orientation controls.

UNIT-I

Introduction

Geometric product definition principles; verification of position with open setup; geometric characteristic symbols Geometric Dimensioning and Tolerancing: an explanation of tolerance zone conversion; surfaces, features, features of size, datum features, datum features of size, and datum's; tolerances; components common to geometrically dimensioned&toleranced drawing; fits & allowances, advantages of GD&T

UNIT-II

Form and Orientation Tolerances

Principles of dimensioning - Introduction to geometric dimensioning and tolerancing (GD&T); Form tolerances: types, specifications and interpretations - measurement and evaluation of straightness, flatness and roundness - Orientation tolerances: types, specifications and interpretations, and verification of orientation tolerances. Exercises on each group.RFS, MMC and LMC concepts.

UNIT-III

Location, Runout and Profile Tolerances

Tolerances of location: types, specifications and interpretations - verification techniques -

Tolerances of profiles of lines and surfaces with or without datums - Tolerances of runout - Tolerancing of angles and cones. Exercises on each group.RFS, MMC and LMC concepts.

UNIT-IV

Surface Roughness

Various parameters and their measurements in two dimensions - filtering and filtering techniques - areal parameters.symbology

Inspection of GD&T call-outs

Vectorial dimensioning and tolerancing - Statistical tolerancing of mechanical assemblies - Dimensional chains - Measurement uncertainty - Computer-aided tolerancing and verification. Inspection techniques- conventional and CMM.

UNIT-V

Datum Feature of Size Representation

Modes of datum feature representation; angular orientation. Form Controls: flatness; straightness: circularity; free state variation; circularity Orientation Controls: orientation characteristics; angularity; perpendicularity Profile; line element controls Run out: circular & total Location: concentricity; the return of symmetry; position

Text Books:

1. Drake, P. J., Dimensioning and Tolerance Handbook, McGraw-Hill, Inc., New York. 1999.

2. Meadows, J. D., Geometric Dimensioning and Tolerancing: Applications and Techniques for use in Design, Manufacturing and Inspection, Marcel Dekker, Inc., New York. 1995.

3. Gill, P. S., Geometric Dimensioning and Tolerancing, S. K. Kataria& Sons, New Delhi.

4. ASME 14.5 - 2009 standards

5. Alex Krulikowski, Fundamentals of geometric dimensionining and tolerancing.

6. James D Meadows, ―Measurement of Geometric Tolerances in Manufacturing**.**

Reference Books:

1. Gupta, I. C., A Textbook of Engineering Metrology, DhanpatRai Publications, New Delhi.

2. Galyer, J. F. W. and C. R. Shotbolt, Metrology for Engineers, Cassell Publishers, London.

3. Henzold, G., Handbook of Geometrical Tolerancing: Design, Manufacturing and Inspection, John Wiley & Sons, Chichester.

4. Muralikrishnan, B. and J. Raja, Computational Surface and Roundness Metrology, Springer, USA.

5. Relevant Indian and International Standards.

6. Whitehouse, D. J., Surfaces and their Measurement, Hermes Penton Science, London**.**

<table>
<tr><td>Course Title</td><td colspan="5">Repair & Rehabilitation of Structures</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">20OE107</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>
</table>

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 and mortars, 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, Maintenance and 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 publications Pvt. 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&D Center (SDCPL).
2. M. S. Shetty, Concrete Technology – Theory and Practice, S. Chand & Co. Ltd., New Delhi.
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="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">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>
</table>

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.

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

CO 1	Understand the different types of contaminants and their effects on subsurface soils
CO 2	Understand the waste contaminants and design the landfill
CO 3	Understand the environmental impacts due to the contaminants of slurry waste
CO 4	Adopt the type of barriers to protect the earth from different contaminants
CO 5	Understand the engineering properties of the waste material and reuse in the construction

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.

<table>
<tr><td>Course Title</td><td colspan="5">Environmental Impact Assessment</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">20OE109</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:
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.</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">Perform a critical quality review of an EIA and EIS.</td></tr>
<tr><td>CO 2</td><td colspan="8">Structure the EIA working process considering the need for interdisciplinary.</td></tr>
<tr><td>CO 3</td><td colspan="8">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.</td></tr>
<tr><td>CO 4</td><td colspan="8">Clarify the concept of EIA and its application in an international context to those involved in or affected by the EIA process.</td></tr>
<tr><td>CO 5</td><td colspan="8">Interpretation an EIA, present its conclusions and translate its conclusions into actions.</td></tr>
</table>

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.

<u>UNIT – V</u>

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,

<u>Text Books:</u>

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.

<u>Reference Books:</u>

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	Intelligent Control Techniques					B. Tech. EEE Open Elective - III		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE205	**Open Elective (OEC)**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exam**	**Total**
		3	**1**	**0**	**3**	**40**	**60**	**100**
Mid Exam Duration: 1Hr30M						**End Exam Duration: 3Hrs**		

Course Objectives: The objective of the course is to learn neural network and fuzzy logic concepts and foster their abilities in designing and implementing soft computing based solutions for real-world and engineering problems.

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

CO 1	Understand architecture and approach to Artificial intelligence
CO 2	Understand the fundamental theory and concepts of neural networks, Identify different neural network architectures, algorithms and their models
CO 3	Understand the concepts of fuzzy sets, knowledge representation using fuzzy rules, approximate reasoning, fuzzy inference systems, and fuzzy logic systems
CO 4	Understand the Bio-inspired and Swarm Intelligence Algorithms

UNIT - I

Introduction to Artificial Intelligence: Introduction and motivation – Approaches to AI – Architectures of AI – Symbolic Reasoning System –Rule based Systems – Knowledge Representation.

UNIT - II

Artificial Neural Networks: Basics of ANN - Comparison between Artificial and Biological Neural Networks – Basic Building Blocks of ANN – Artificial Neural Network Terminologies – McCulloch Pitts Neuron Model – Learning Rules.

UNIT - III

ADALINE and MADALINE Models – Perceptron Networks – Back Propagation Neural Networks – Associative Memories Neural Networks as Associative Memories

UNIT - IV

Fuzzy Logic: Classical Sets – Fuzzy Sets – Fuzzy Properties and Operations – Fuzzy Logic System – Fuzzification – Defuzzification – Membership Functions – Fuzzy Rule base – Fuzzy Logic Controller Design.

UNIT - V

Evolutionary Computation - Overview of other Bio-inspired Algorithms - Swarm Intelligence Algorithms

Text Books

1. Introduction to Neural Networks using MATLAB by S. N. Sivanandam, S. Sumathi and S. N. Deepa, Tata McGraw Hill Edition, 2006.
2. Kumar S., “Neural Networks - A Classroom Approach”, Tata McGraw Hill, 2004.
3. Fuzzy Logic with Engineering Applications by Timothy J. Ross, WILEY India Edition, 3rd Edition, 2012.

Reference Books

1. Intelligent System – Modeling, Optimization & Control by Yung C. Shin and Chengying Xu, CRC Press, 2009.
2. Eiben A. E. and Smith J. E., “Introduction to Evolutionary Computing”, Second Edition, Springer, Natural Computing Series, 2007.
3. Engelbrecht A. P., “Fundamentals of Computational Swarm Intelligence”, John Wiley & Sons, 2006.

Course Title	**Electrical System Estimation & Costing**					**B. Tech. EEE Open Elective - III**		
Course Code	**Category**	**Hours/Wee k**			**Credit s**	**Maximum Marks**		
20OE206	Open Elective (OEC)	**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 about estimating and costing of wiring systems, earthing systems, various light schemes and its calculations.								
Course Outcomes: On successful completion of this course, the students will be able to								
CO 1	Understand principles of wiring systems and its estimation based on choice of wiring system							
CO 2	Understand the concepts of earthing systems							
CO 3	Understand various lightening schemes and its calculations used for domestic and industrial applications							
CO 4	Analyze estimation of wiring to residential & commercial buildings							

UNIT-I

General principles of estimating: Estimating – purpose of estimating and costing – catalogues – market survey and source selection - determination of required quantity of materials – determination of cost material and labor.

Wiring systems: Introduction – Systems of distribution of electrical energy – methods of wiring – systems of wiring – choice of wiring systems.

UNIT – II

Earthing Systems: Earthing – Points to be earthed – Factors influencing earth resistance – methods od reducing Earth resistance – Design data on earth electrodes – Methods of earthing – determination of size of earth wire and earth plate – Effects of electric current on Human body – Measurement of earth resistance.

UNIT - III

Lighting schemes and calculations: Types of lighting circuits – Various circuit diagrams – Two way switching – Aspects of good lighting service – Types of lighting schemes – Filament Lamps- Gas filled Lamps – Fluorescent Tubes - LED lamp – Compact Fluorescent lamp (CFL) – comparison between LED and CFL – terms used in illumination – laws of illumination.

UNIT - IV

Estimation of lighting schemes: Design of lighting schemes - Factory lighting – Public lighting installations: Classification – General principles – Design – Selection of equipment - Street lighting – Methods of lighting calculations.

UNIT-V

Internal wiring estimation: General rules for wiring – determination of number of points – determination of total load – determination of sub circuits – determination of ratings of main switch and distribution board – determination of size of conductor – layout – simple problems.

Text books

1. Electrical installation estimating & Costing – J.B.Gupta, S.K.Kataria& sons.
2. Electrical design estimating and costing – K.B.Raina&S.K.Bhattacharya, NewAge International (P) Limited publishers.

Reference Books

1. Power System Analysis and Design – Dr.B.R.Gupta, S.Chand Publications
2. Electrical Estimating methods – Wayne J.Del Pico, Wiley Publishers

<table>
<tr><td>Course Title</td><td colspan="4">Introduction to IOT</td><td colspan="4">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>
</table>

Course Objectives:

- To understand the basics of IOT.
- To study the Programming Using Arduino.
- To provide the knowledge about sensors and transducers.

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

CO 1	Understand about IoT, its Architecture and its Applications, basic electronics used in IoT & its role.
CO 2	Develop applications with C using Arduino IDE.
CO 3	Analyze about sensors and actuators.
CO 4	Design IoT in real time applications using today's internet & wireless technologies.

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.

<table>
<tr><td rowspan="2">Course Title</td><td colspan="4" rowspan="2">Nano Electronics</td><td colspan="4" rowspan="2">Open Electives</td></tr>
<tr></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">20OE407</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 principles of tunneling, lithography and scaling of physical systems.
• To provide the knowledge about MEMS and NEMS.</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 divers electronic and device fabrication.</td></tr>
<tr><td>CO 2</td><td colspan="8">Demonstrate the applications of FET and MOSFET</td></tr>
<tr><td>CO 3</td><td colspan="8">Describe lithography.</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze MEMS and NEMS</td></tr>
</table>

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

CO 1	Understand the basic concepts related to the operating systems.
CO 2	Analyze the various process scheduling algorithms and process synchronization mechanisms.
CO 3	Analyze the various memory management schemes.
CO 4	Understand the ways to deal the deadlocks and the basic concepts related to files in the system.
CO 5	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, 4th Edition, S Chand Publishers.

Course Title	R Programming (Open Elective Course - III)					B.Tech VII Sem (R20) CSE		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE506	**OEC**	**L**	**T**	**P**	**C**	**Continuous Internal Assessment**	**End Exams**	**Total**
		3	**0**	**0**	**3**	**40**	**60**	**100**
					End Exam Duration: 3Hrs			

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.

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

CO 1	Understand the installation of VMW is and PIG.
CO 2	Understand and apply the setting up and Installing Hadoop in its three operating modes.
CO 3	Implement the file management tasks in Hadoop.
CO 4	Understand Map Reduce Paradigm.
CO 5	Understand Pig Latin scripts sort, group, join, project, and filter your data.

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(), userdefined 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.

<table>
<tr><td>Course Title</td><td colspan="4">CYBER SECURITY
(Open Elective Course – III)</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">20OE3905</td><td rowspan="2">PEC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>EndExam</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:

- 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 ComputingEra, 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, CRC Press T&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.

<table>
<tr><td>Course Title</td><td colspan="4">JAVA PROGRAMMING
(Open Elective Course – III)</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">20OE3906</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: 3 Hrs</td></tr>
</table>

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 OOPconcepts.

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.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand Laplace Transforms in engineering problems.

UNIT II:

Inverse Laplace Transforms. Convolution theorem – Applications of Laplace transforms to ordinary differential equations.

Learning Outcomes:

At the end of this unit, the student will be able to

- Apply Laplace Transforms in engineering problems.

UNIT III:

Fourier integral theorem (only statement) – Fourier sine and cosine integrals. Fourier transform – Fourier sine and cosine transforms – Properties of Fourier transform.

Learning Outcomes:

At the end of this unit, the student will be able to

- Understand Fourier Transforms in engineering problems.

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).

Learning Outcomes:
At the end of this unit, the student will be able to

- Apply Fourier Transforms in engineering problems.

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.

Learning Outcomes:
At the end of this unit, the student will be able to

- Understand concept of Z-Transforms and its applications.

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. 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, 11th 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:

3. http://www.law.du.edu/index.php/the-renewable-energy-reader/6-geothermal

Course Title	**Fuel Technology**					**B. Tech. (Open elective-III)**		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE614	**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:

- 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

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

CO 1	**Recall** the Characteristics & properties of a fuel.
CO 2	**Analyze** the concepts of solid fuels and evaluate the calorific value of solid fuels by Bomb Calorimeter.
CO 3	**Explore** the synthesis of synthetic petrol & process of Refining of petroleum.
CO 4	**Identify** various gaseous fuels and explain their preparation and properties.
CO 5	**Discuss** about the purpose of different alternative fuels, merits & demerits of alternative fuels

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.

Learning Outcomes:

At the end of the unit, The students will be able to

- Classification of fuels
- Analyze the characteristics of a good fuel

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,

Learning Outcomes:

At the end of the unit, The students will be able to

- Explain the advantages and disadvantages of solid fuel
- Determine the calorific value of 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

Learning Outcomes:
At the end of the unit, The students will be able to

- Explain the advantages and disadvantages of Liquid fuel.
- Discuss about refining of petroleum and uses of various petroleum products.

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.

Learning Outcomes:
At the end of the unit, The students will be able to

- Explain the advantages and disadvantages of Gaseous fuel.
- Preparation and properties of different types of gaseous fuels

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.

Learning Outcomes:
At the end of the unit, The students will be able to

- Know about the effects of exhaust gas emissions on environment and humans.
- Analyze the merits and 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, 2^{nd} 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**			

Objectives:

- To help the students get on in their professions and get success professionally.
- To help the students learn communication techniques.
- To make the students thorough with presentation skills to become effective participants in various discussions.

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

Syllabus

Unit :1

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.

3. Meenakshi Raman and Sangeetha Sharma, “Technical Communication: Principles Practice”, 2ndEdition, 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 edition,2015.

10. The Ace of Soft Skills: Attitude, Communication and Etiquette for Success, Pearson Education; 1edition, 2013.

Course Title	Digital & Social Media Management					B. Tech. Open Elective - III		
Course Code	**Category**	**Hours/Week**			**Credits**	**Maximum Marks**		
20OE616	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

- 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

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

CO 1	Explain the role and importance of digital marketing, Ability to comprehend how digital media can be used for current marketing practices.
CO 2	Understanding of Search Engine optimization, Pay per click and Email marketing,
CO 3	Analyze the role that social media marketing plays in the digital landscape and marketing mix.
CO 4	Identify and incorporate individual social and mobile media platforms into a digital marketing strategy.
CO 5	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.

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. Cyber crime 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

<table>
<tr><td>Course Title</td><td colspan="5">Industrial Safety Engineering</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">20OE110</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>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>
</table>

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>
</table>

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.

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

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.

<table>
<tr><td>Course Title</td><td colspan="5">Traffic Engineering</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">20OE112</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>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>
</table>

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-Hill Companies, Inc. NewYork.
2. Partha Chakroborthy, Animesh Das, "Principles of Transportation Engineering", Prentice Hall 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.

<table>
<tr><td>Course Title</td><td colspan="4">Basics of Power Electronics</td><td colspan="3">B. Tech. EEE
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">20OE207</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: 1Hr30M</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 fundamentals of power electronics devices and to classify the different kinds of power electronics circuits as a function of the input source and loads.</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 characteristics of different power switches.</td></tr>
<tr><td>CO 2</td><td colspan="8">To understand the single phase and three phase controlled rectifier with different loads</td></tr>
<tr><td>CO 3</td><td colspan="8">To understand the operating principle of cyclo converters, choppers and inverters</td></tr>
<tr><td>CO 4</td><td colspan="8">To understand harmonic content in output voltage and current waveforms of an inverter.</td></tr>
</table>

UNIT - I

Fundamentals of Power Semi-conductor devices: SCR – static characteristics –turn on and off mechanism – MOSFET, IGBT, GTO Characteristics.

UNIT - II

Phase controlled Rectifiers(AC to DC): Phase controlled rectifiers – single phase half and fully controlled converters – midpoint and bridge connections with R and RL loads – effect of source inductance- three phase half controlled converters with R load .

UNIT - III

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

UNIT - IV

Choppers (DC to DC): Choppers – principle of operation – control strategies- types of chopper circuits – type A, type B- buck -boost converter.

UNIT - V

Inverters (DC to AC): Inverters – single phase half bridge and full bridge inverters with R and RL load –output voltage control techniques - PWM techniques- harmonic reduction techniques.

Text Books

1. Power Electronics –M.D Singh & K.B. Kanchandhani, TMH publications, 1998.
2. Power Electronics - Circuits, Devices and Applications –M.H. Rashid, Prentice Hall of India, 2nd Edition 1998.

Reference Books

1. Power Electronics- P.S. Bimbhra, Khanna Publications.
2. Power Electronics –Vedam Subramanyam, New Age Information Limited, 3rd Edition.
3. Power Electronics –V.R. Murthy, Oxford University Press, 1st Edition – 2005.
4. Power Electronics –P.C Sen, Tata Mc Graw Hill Publishing.

<table>
<tr><td>Course Title</td><td colspan="4">System Reliability Concepts</td><td colspan="3">B. Tech. EEE
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">20OE208</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>1</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 course is to learn basic probability theory, network modeling, time dependent probability, markov modeling and system reliability evaluation.</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 concept of basic probability theory, binomial distribution, network reliability, reliability functions, time dependent probability, markov chains & process and system reliability</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply probability rules to find probability distributions, network reliability for series, parallel, series-parallel, complex networks</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the failure rate distributions, bath-tub curve, STPM, continuous markov process and frequency duration techniques for single and two repairable components</td></tr>
<tr><td>CO 4</td><td colspan="8">Evaluate transitional rates, cumulative probability and frequency n-component repairable models</td></tr>
</table>

UNIT-I

Basic Probability Theory: Basic concepts – Rules for combining Probabilities of events – Failure Density and Distribution functions – Bernoulli's trials – Binomial distribution – Expected value and standard deviation for binomial distribution – Examples.

UNIT-II

Network Modeling and Reliability Evaluation: Basic concepts – Evaluation of network Reliability / Unreliability – Series systems, Parallel systems, Series - Parallel systems, partially redundant systems – Types of redundancies - Evaluation of network Reliability / Unreliability using conditional probability method – Paths based and Cut set based approach – Examples.

UNIT-III

Time Dependent Probability: Basic concepts – Reliability functions f(t), F(t), R(t), h(t) – Relationship between these functions – Bath tub curve – Expected value and standard deviation of Exponential distribution – Measures of reliability – MTTF, MTTR, MTBF – Evaluation of network reliability / Unreliability of simple Series, Parallel – Examples.

UNIT-IV

Discrete Markov Chains: Basic concepts – Stochastic transitional Probability matrix (STPM) – Limiting State Probability evaluation – Absorbing states.

Continuous Markov Processes: Modeling concepts – State space diagrams – time dependent reliability evaluation of single component repairable model – Evaluation of Limiting State Probabilities of one, two component repairable models – Frequency and duration concepts – Frequency balance approach.

UNIT-V

Multi Component & Approximate System Reliability Evaluation: Recursive relation for evaluation of equivalent transitional rates, cumulative probability and cumulative frequency and 'n' component repairable model - Series systems, Parallel systems, Basic reliability indices – Cut-set approach – Examples.

Text Books

1. Reliability Evaluation of Engineering Systems by Roy Billinton and Ronald N. Allan, Reprinted in India B. S. Publications, 2007.
2. System Reliability Concepts by V. Sankar, Himalaya Publishing House, 2015.

Reference Books

1. Reliability Engineering by E. Balagurusamy, Tata McGraw Hill, 2003.
2. Reliability and Maintainability Engineering by Charles E. Ebeling, Tata McGraw Hill, 2000.

<table>
<tr><td>Course Title</td><td colspan="4">Fundamentals of RADAR Engineering</td><td colspan="4">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">20OE408</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 gain the knowledge about radar subsystems, their performance and key functions.
• To provide the in depth knowledge and issues related various tracking radars.</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 essential principles of operation of radar systems.</td></tr>
<tr><td>CO 2</td><td colspan="8">Describe the various Radar components</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze different Radar systems</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze the different Tracking methods</td></tr>
</table>

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”, 2nd edition-TMH 1980.

2. N.S. Nagaraja, “Elements of electronic navigation, 2nd edition-TMH 1996.

<table>
<tr><td>Course Title</td><td colspan="5">Biomedical Instrumentation</td><td colspan="3">Minor Degree</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">2091409</td><td rowspan="2">EC</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>
</table>

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.

<table>
<tr><td>Course Title</td><td colspan="5">Digital Circuits</td><td colspan="3">Minor Degree</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">2091410</td><td rowspan="2">EC</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 provide fundamentals of number systems and Boolean Algebra.
• To learn the design of combinational and sequential circuits.
• To teach various memories and PLDs.</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 number systems and binary codes.</td></tr>
<tr><td>CO 2</td><td colspan="8">Understand the postulates, theorems and properties of Boolean algebra.</td></tr>
<tr><td>CO 3</td><td colspan="8">Describe the correlation between the Boolean expression and their corresponding logic diagram.</td></tr>
<tr><td>CO 4</td><td colspan="8">Analyze Combinational & sequential logic circuits.</td></tr>
<tr><td>CO 5</td><td colspan="8">Solve Switching functions using Programmable Logic Devices.</td></tr>
</table>

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,

<table>
<tr><td>Course Title</td><td colspan="5">Python Programming
(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">20OE508</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>
</table>

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]

<u>Text Books:</u>

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.

<u>Reference Books:</u>

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="5">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 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>
</table>

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.

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

CO 1	Recall different Computing Paradigms and overview of cloud computing.
CO 2	Understanding the Cloud Computing Architecture, network connectivity and cloud migration strategy.
CO 3	Explain and characterize different cloud deployment models, service models.
CO 4	Understanding virtualization, Programming models and Software Development in Cloud Computing.
CO 5	Understanding Cloud Service Providers AWS and Microsoft cloud Services.

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="3">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 andexpressions, 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.

<table>
<tr><td>Course Title</td><td colspan="4">WEB DESIGNING USING PHP
(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">20OE3908</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: 3Hrs</td></tr>
<tr><td colspan="9">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.</td></tr>
<tr><td colspan="9">Course Outcomes: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO1</td><td colspan="8">Enumerate the Basic Concepts of Markup Languages.</td></tr>
<tr><td>CO2</td><td colspan="8">Develop web Applications using CSS and different page layout.</td></tr>
<tr><td>CO3</td><td colspan="8">Make use of decisions, loops, strings in PHP</td></tr>
<tr><td>CO4</td><td colspan="8">Make use of functions, creating HTML forms with PHP.</td></tr>
<tr><td>CO5</td><td colspan="8">Accessing database through PHP.</td></tr>
</table>

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="4">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>
<tr><td colspan="9">Course Outcome: On successful completion of this course, the students will be able to</td></tr>
<tr><td>CO 1</td><td colspan="8">Understand various concepts of Operations research.</td></tr>
<tr><td>CO 2</td><td colspan="8">Apply linear programming to optimization techniques.</td></tr>
<tr><td>CO 3</td><td colspan="8">Discuss Transportation problem.</td></tr>
<tr><td>CO 4</td><td colspan="8">Solve Assignment problem.</td></tr>
<tr><td>CO 5</td><td colspan="8">Distinguish a game situation from a pure individual's decision problem and to explain concepts of players, strategies, payoffs, rationality.</td></tr>
</table>

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.

<table>
<tr><td>Course Title</td><td colspan="5">FUNDAMENTALS OF QUANTUM COMPUTATION AND NANO PHOTONICS</td><td colspan="3">OPEN ELECTIVE - 4</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">180E2618</td><td rowspan="2">BSC</td><td>L</td><td>T</td><td>P</td><td>C</td><td>Continuous Internal Assessment</td><td>End lab Exams</td><td>Total</td></tr>
<tr><td>3</td><td>0</td><td>0</td><td>3</td><td>30</td><td>70</td><td>100</td></tr>
<tr><td colspan="5"></td><td colspan="4">End Exam Duration: 3Hrs</td></tr>
</table>

COURSE OBJECTIVES:

1. This course outlines physically the intuitive concepts of quantum computation and nanophotonics using the concept of optical near-fields.
2. 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.
3. 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="4">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.
o 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.
Learning Outcomes:
After completing this unit, the student will be able to
- Summarize the principles in green chemistry.
- Understand the importance of green chemistry in future development

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.
Learning Outcomes:
After completing this unit, the student will be able to
- Explain the importance of designing of safer chemicals.
- Interpret the need for selection of appropriate solvents and starting materials in chemical reactions.

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.
Learning Outcomes:
After completing this unit, the student will be able to
- Know the use of biocatalysts.
- Explain transition metal catalysis reactions

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.

Learning Outcomes:
After completing this unit, the student will be able to
- Explain solvent free reactions in green synthesis
- Understand the importance of ultrasound assisted Green synthesis

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

References:

1. Text Book of Engineering Chemistry by S.S. Dara & Mukkati S. Chand & Co Publishers, New Delhi, 2006.
2. Handbook of Green chemistry and technology, James H. Clark, Duncan J. MacQuarrie, Blackwell, Abingdon,2002
3. An Introduction Text on Green Chemistry, Indu Tucker Sidhwani, Rakesh K. Sharma, Wiley Publications
4. Green Organic Chemistry in Lecture and laboratory, Andrew P. Dicks & Michael C. Cann, T& F India publications.

<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:

- Creative Writing: A Beginner's Manual AnjanaNeira Dev. AnuradhaMarwah, Swati Pal Delhi,
  Pearson Longman, 2009.
- Abrams, M.H. Glossary of Literary Terms. Boston: Wadsworth Publishing Company,2005.
- Elements of Literature: Essay, Fiction, Poetry, Drama, Film. Robert Scholes, Nancy R. Comley, Carl H. Klaus, Michael Silverman Delhi, OUP, 2007.
- Write from the Heart: Unleashing the power of Your Creativity. Hal ZinaBennet California, New World Library,2001.
- A Guide to Writing about Literature, Sylvan Bamet, William E.Cain, New Delhi, Pearson, 2006.
- Atwood, Margaret. Negotiating with the Dead: A Writer on Writing. Cambridge: CUP,2002.
- Bell, Julia and Magrs, Paul. The Creative Writing Course-Book. London: Macmillan,2001.
- Earnshaw, Steven (Ed). The Handbook of Creative Writing. Edinburgh: EUP, 2007.
- Show, Mark. Successful Writing for Design, Advertising and Marketing. New York: Laurence King, 2012.
- Sugrman, Joseph .The Adweek Copywriting Handbook: The Ultimate Guide to WritingPowerful Advertising and Marketing Copy from One of America's Top Copywriters. NewYork: Wiley, 2009.

Cyber Resources:

http://www.chillibreeze.com/articles_various/creativewriter.asp

http://www.contentwriter.in/articles/writing/

http://www.cbse.nic.in/cw-xii/creative-writing-xii-unit-1.pdf.

<table>
<tr><td>Course Title</td><td colspan="5">Materials Management</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">20OE621</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
• 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.</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">Remembering the concepts of purchases, vendors, materials handling, inventory types etc.</td></tr>
<tr><td>CO 2</td><td colspan="8">An understanding of basic concepts in Materials management and modern trends inmaterials management</td></tr>
<tr><td>CO 3</td><td colspan="8">Analyze the processes of vendor management, material handling, ABC analysis andEOQ etc...</td></tr>
<tr><td>CO 4</td><td colspan="8">An understanding of principle of materials handling and evaluation of material handling performance.</td></tr>
<tr><td>CO 5</td><td colspan="8">Able to apply the techniques of inventory management.</td></tr>
</table>

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:

Material Management by K. ShridharaBhat

Reference Books:

1. Purchasing and Materials Management, P Gopalkrishnan,

2. Materials Management - An Integrated Approach, P Gopalkrishnan, M. Sundaresan, PHI.

3. Materials Management, Procedures, Text and Cases, A K Datta, PHI.

4. Production & Operation Management by K Ashwathappa, K ShridharaBhat

<table>
<tr><td>Course Title</td><td colspan="5">HUMAN RESOURCE DEVELOPMENT (Humanities Open Elective)</td><td colspan="3">B.Tech. VI Sem
ECE, CE, -VI Sem
ME, CSE, AI & ML, EEE – 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">2006601/ 2006701</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>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">External Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives: The main objective of the course is to learn

- To develop capability of all individuals working in an organization in relation to their present role
- To develop team spirit.
- To develop co-ordination among different units of an organization.
- To develop organization health by continuous reveal of individual capability keeping peace with the technological changes.
- To develop better interpersonal & employer-employee relationships in an organization.

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

CO1	To understand key functions in management as applied in practice.
CO2	To understand in more specific management related areas from planning till controlling.
CO3	To understand about the authority and responsibility, and different organizational structure..
CO4	To understand about the role of leadership, motivation and communication in an organization.
CO5	To understand the importance of globalization and diversity in modern organizations.

Unit I

Introduction to Human Resource Development: Meaning, significance and objectives of Human Resource Development, Human Resource Management and Human Resource development functions, Human Resource Development challenges

Unit II

HRD Need Assessment & Designing of HRD programs: Strategic/ Organizational Analysis-Task Analysis- Person Analysis- prioritizing HRD needs, defining the objectives of HRD Intervention - Selecting the trainer - Selecting the Training methods - Preparing training material Scheduling an HRD program

Unit III

Implementation &Evaluation of HRD programs: Training methods - Classroom training Approaches - Computer based Training, Purpose of HRD Evaluation- Kirkpatrick's evaluation frame work - Data collection for HRD Evaluation - Assessing the impact of HRD programs in Monetary Terms

Unit IV

Career Management and Development: Introduction to Career management, meaning - Stages of life and Career Development - process of career Development - Issues in career development.

Unit V

HRD & Diversity: Introduction – Organizational culture – Labor Market changes and discrimination adapting to demographic changes

Text books:

1. Jon M Werner, Randy L De Simone: Human Resource development (Thomson/Cengage)
2. Raymond A Noe: Employee Trainee Development (Tata McGraw Hill)
3. Dr. D.K Bhattacharya, Himalaya Publishing House

References:

1. John P. Wilson Human Resource Development (Kogan Page Business Books)
2. Tripathi P.C : Human Resource Development (Sultan Chand & Sons)
3. Uday Kumar Haldar : Human Resource Development (Oxford)

<table>
<tr><td>Course Title</td><td colspan="5">Digital Marketing
(Humanities Open Elective)</td><td colspan="3">B.Tech. VI Sem
ECE, CE, -VI Sem
ME, CSE, AI & ML, EEE – 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">2006602/
2006702</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>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">External Exam Duration: 3Hrs</td></tr>
</table>

Course Objectives: The main objective of the course is to learn

- To provide foundation in the key concepts on digital marketing.
- Understand how and why to use digital marketing for multiple goals within a larger marketing and/or media strategy.
- Learn to develop, evaluate, and execute a comprehensive digital marketing strategy and plan.
- Understand the major digital marketing channels - online advertising: Digital display, video, mobile, search engine, and social media
- Learn how to measure digital marketing efforts and calculate ROI

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

CO1	**Analyze** the confluence of marketing, operations, and human resources in real-time delivery.
CO2	Demonstrate cognitive knowledge of the skills required in conducting online research and research on online markets, as well as in identifying, assessing and selecting digital market opportunities.
CO3	Explain emerging trends in digital marketing and critically assess the use of digital marketing tools by applying relevant marketing theories and frameworks.
CO4	Investigate and evaluate issues in adapting to globalized markets that are constantly changing and increasingly networked.
CO5	Interpret the traditional marketing mix within the context of a changing and extended range of digital strategies and tactics.

UNIT - I

Understanding Digital Marketing: Concept, Components of Digital Marketing, Need and Scope of Digital Marketing, Benefits of Digital Marketing, Digital Marketing Platforms and Strategies, Comparison of Marketing and Digital Marketing, Digital Marketing Trends.

UNIT - II

Channels of Digital Marketing: Digital Marketing, Website Marketing, Search Engine Marketing, Online Advertising, Email Marketing, Blog Marketing, Social Media Marketing, Mobile Marketing, Migrating from Traditional Channels to Digital Channels. Marketing in the

Digital Era Segmentation – Importance of Audience Segmentation, How Different Segments use Digital Media - Digital Media for Customer Loyalty.

UNIT – III

Digital Marketing Plan: Need of a Digital Marketing Plan, Elements of a Digital Marketing Plan – Marketing Plan, Executive Summary, Mission, Situational Analysis, Opportunities and Issues, Goals and Objectives, Marketing Strategy, Action Plan, Budget, Writing the Marketing Plan and Implementing the Plan.

UNIT – IV

Search Engine Marketing and Online Advertising: Importance of SEM, Understanding Web Search – Keywords, HTML Tags, Inbound Links, Online Advertising vs. Traditional Advertising, Payment Methods of Online Advertising – CPM (Cost-per-Thousand) and CPC (Cost-per-Click), Display Ads - Choosing a Display Ad Format, Landing Page and its Importance.

UNIT – V

Social Media Marketing: Understanding Social Media, Social Networking with Face book, LinkedIn, Blogging as a Social Medium, Social Sharing with YouTube. Measurement of Digital Media: Analyzing Digital Media Performance, Analyzing Website Performance, Analyzing Advertising Performance.

Text Books:

1. Seema Gupta, Tata McGraw Hill.
2. Dave Chaffey, Pearson Education
3. Dr Antorny Puthussery

Reference Books:

1. Kevin Hartman, Digital Marketing Analytics,
2. Digital Marketing – Self learning management series, Vibrant Publishers
3. Digital Marketing, Vandana Ahuja, Oxford publishing house
4. Fundamentals of Digital Marketing, Puneet Singh Batia – Pearson Education
5. Digital Marketing by Seema Gupta (IIM-B)
6. Digital Marketing: Strategy, Implementation← & Practice by Dave Chaffey & Fiona Ellis Chad wick
7. Understanding Digital Marketing: Marketing Strategies for Engaging the Digital Generation - Damian Ryan and Calvin Jones.

<table>
<tr><td>Course Title</td><td colspan="4">Project Management
(Humanities Open Elective)</td><td colspan="3">B.Tech. VI Sem
ECE, CE, -VI Sem
ME, CSE, AI & ML, EEE – 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">2006603/
2006703</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>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">External Exam Duration: 3Hrs</td></tr>
<tr><td colspan="9">Course Objectives: The main objective of the course to learn
• To impart the basic concepts of Project selection.
• To develop an understanding of Project Planning and design, construction and execution, monitoring and control, completion.
• To achieve the Project's main goal within the constraints.
• To optimize the allocated necessary inputs.
• To shape and reform the client's vision or tone got late with the masregards the project's objectives.</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">Remembering and recalling the principles of project management and methods involved in the process of project management.</td></tr>
<tr><td>CO2</td><td colspan="8">Understanding of Project Planning, design, construction, execution, maintaining and controlling</td></tr>
<tr><td>CO3</td><td colspan="8">Applying techniques in Project Evaluation, Scheduling and Controlling.</td></tr>
<tr><td>CO4</td><td colspan="8">Classifying and analysis risks in Project management and project scheduling</td></tr>
</table>

UNIT-I

Introduction to Project Management: Need for Project management, Taxonomy of project, Project life cycle, Project management Process, Principles of Project Management. Project Identification and Selection, Pre – feasibility study, Project Planning Process, Resources allocation, Project Break-even Point.

UNIT- II

Financial Evaluation of Projects: Cost of the Project, Means of finance, Financial Evaluation of projects – Payback period method, Accounting Rate of Return method, Net Present Value method, Internal Rate of Return method, Benefit Cost Ratio method (Profitability Index), (simple Problems).

UNIT-III

Project Risk & Quality Management: Introduction, Role of Risk management, Risk Identification – Steps in risk management –, Risk analysis (Sensitivity Analysis, Probability Analysis, Mean – Variance Analysis Decision trees, Simulation), Techniques for managing risk. Project Quality Management and Value Engineering: Quality, Quality Concepts and Value Engineering.

UNIT-IV

Project Scheduling (Network Analysis): Development of Project network, Time estimation, Determination of the critical Path, PERT Model, Project Crashing.(Simple Problems)

UNIT-V

Project Execution & PMS: Process Of Project Execution and Control, Project Management Information System (PMIS), Project Performance Measurement and Evaluation (PPME).

Project Management Software: Essential Requirement of Project Management Software, Common Features available in most of the project management software.

Text Books:

1. Project management Best Practices: Achieving Global Excellence by Harold Kerzner; John Wiley & Sons; 3rd edition.
2. Project Management: Engineering, Technology and Implementation: united states Edition by Avraham Shtub and Jonathan F. Bard, Pearson; 1st edition.
3. The Essentials of Project Management by Dennis Lock; Routledge.
4. Prasanna Chandra, Projects, Tata Mc Graw Hill.
5. Nagarajan K, Project Management 4th edition, New Age International(P)Ltd.

L S Srinath, PERT/CPM, AffiliatedEast-WestPress2005.

Reference Books:

1. Project management by Stephen Hartley; Routledge, 4th Edition.
2. Project management: a systems Approach to Planning, Scheduling, and controlling by Harold Kerzner; Wiley; 12th edition.
3. Project Management & Appraisal by Sitangshu Khatua; published by Oxford University.
4. Nicholas J.M. &Steyn H, Project Management, Elsevier, Himalaya publications.
5. Narendra Singh, Project Management and Control, HPH,2003.
6. Harvey Maylor, Project Management, Pearson Education.
7. Panneer selvam Senthil kumar, Project Management, PHI.

<table>
<tr><td>Course Title</td><td colspan="5">Internship</td><td colspan="3">B.Tech ME 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">2003716</td><td rowspan="2">PROJECT</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></td><td>2</td><td>100</td><td></td><td>100</td></tr>
<tr><td colspan="5">Mid Exam Duration:</td><td colspan="4">End Exam Duration:</td></tr>
<tr><td colspan="9">Course Objectives: The objective of the project is to enable the student to take up investigative study in industry in the field of Mechanical Engineering and Ability to articulate what was learned and how it will be apply to your professional career goals.</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">The student will append, to their internship contract, a statement of at least 250 words which explains how this internship contributes to their academic and career goals</td></tr>
<tr><td>CO 2</td><td colspan="8">Identify and transfer existing ideas into new contexts and applications.</td></tr>
<tr><td>CO 3</td><td colspan="8">Apply and transfer academic knowledge into the real-world.</td></tr>
<tr><td>CO 4</td><td colspan="8">Design a component or a product applying all the relevant standards and with realistic constraints.</td></tr>
</table>

The following are the rules and regulation for **INTERNSHIP:**

1. The student has to spend 40 to 50 Hrs in the semester on any Internship and submit a report for evaluation.
2. 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.
3. A student shall acquire 2 credits assigned, when he/she secures 50% or more marks from the total of 100 marks.
4. In case, if a student fails, he/she shall resubmit the report.
5. There is no external evaluation for the Internship.

B.Tech VIII SEM ME (R20)

Course Title	Project					B.Tech ME VIII Sem (R20)		
Course Code	Category	Hours/Week			Credits	Maximum Marks		
2003801	PROJECT	L	T	P	C	Continuous Internal Assessment	End Exam	Total
		--	--	-	12	40	60	100

Course Objective: The objective of the project is to enable the student to take up investigative study in rural areas in the field of Mechanical Engineering

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 **Project:**

1. The student has to spend 40 to 50 Hrs in the semester on any socially relevant project and submit a report for evaluation.
2. 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 and out side Expert.
3. A student shall acquire 12 credits assigned, when he/she secures 70% or more marks from the total of 100 marks.
4. In case, if a student fails, he/she shall resubmit the report.