NARASARAOPETA
NEC ENGINEERING COLLEGE
(AUTONOMOUS)

Course Structure and Syllabus

(R20 Regulations)

Mechanical Engineering

B. Tech -4 Years
(Applicable for the Batches admitted from 2020-21)

NEC
NARASARAOPETA
ENGINEERING COLLEGE
(AUTONOMOUS)

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(AUTONOMOUS)

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Accredited by NBA & NAAC, RTA Approved Pollution test Centre, ISO 9001: 2008 Certified Institution
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CURRICULAR FRAMEWORK FOR REGULAR, MINORS AND HONORS B.TECH PROGRAMMES OF ALL BRANCHES

1. PREAMBLE

The rapid transformation in every sphere of life is augmenting the need to prepare the present fast-paced generation to adapt to the changing knowledge & skill requirement on a life-long basis, in the fields of science, engineering, technology and humanities to influence society positively. The future looks up to multi-disciplinary, competent leaders who are Information and Communication Technology ready and driven by strong ethical values.

NEC envisions to nurture knowledge, skills, and attitude and values of the aspiring youth to enable them to become global citizens and towards that process, the institution has evolved a flexible integrated academic curriculum.

NEC introduced Outcome Based Education (OBE) and Choice Based Credit System (CBCS), which emphasized on honing the skills and knowledge of the graduates.

The Engineering curriculum is revised with an objective to fill the gaps in the existing curriculum with reference to skill development. The revised curriculum underwent a reorganization making the engineering education enshrined with skill development ecosystem to suit the industry's needs and to ensure the graduates employability.

The curriculum mandates students to take up five skill courses, Out of the five skill courses two shall be skill-oriented courses from the same domain and shall be completed in second year. Of the remaining 3 skill courses, one shall be necessarily be a soft skill course and the remaining 2 shall be skill-advanced courses either from the same domain or Job oriented skill courses, which can be of inter disciplinary nature. The students are also given the option of choosing between skill courses offered by the college and a certificate course offered by industry, a professional body, APSSDC or any other accredited body.

Another major change brought in the curriculum is the introduction of B.Tech with Honors or a B.Tech. with a Minor. This is to give an opportunity for the fast learners to earn additional credits either in the same domain or in a related domain, making them more proficient in their chosen field of discipline or be a graduate with multidisciplinary knowledge and job ready skills.

2. PROGRAMS OFFERED BY THE COLLEGE

Narasaraopeta Engineering College (NEC) offers a 4-year (8 semesters) **Bachelor of Technology** (B. Tech.) degree programme, under Choice Based Credit System (CBCS) for the following branches of Engineering.

S. No.	Name of the Program	Program Code
1.	Civil Engineering	01
2.	Electrical and Electronics Engineering	02
3.	Mechanical Engineering	03
4.	Electronics and Communication Engineering	04
5.	Computer Science and Engineering	05
6.	Information Technology	12
7.	CSE (Artificial Intelligence and Machine Learning)	42
8.	CSE (Artificial Intelligence)	43
9.	CSE(Data Science)	44
10.	CSE (Cyber Security)	46

3. ELIGIBILITY FOR ADMISSION

The total seats available as per the approved intake are grouped into two categories viz. category A and Category B with a ratio of 70:30 as per the state government guidelines vide G.O No.52.

The admissions for category A and B seats shall be as per the guidelines of Andhra Pradesh State Council for Higher Education (APSCHE) in consonance with government reservation policy.

a. Under Category A: 70% of the seats are filled through EAPCET counselling.
b. Under Category B: 30% seats are filled based on 10+2 merits in compliance with guidelines of APSCHE

Eligibility for Admission - Under Lateral Entry Scheme (LES)

Students with diploma qualification have an option of direct admission into 2nd year B. Tech. (Lateral Entry Scheme). Under this scheme 10% seats of sanctioned intake will be available in each course as supernumerary seats. Admissions to this three-year B.Tech. Lateral entry Programme will be through ECET.

4. AWARD OF THE DEGREE:

For Regular and LES (Lateral Entry Scheme) **students**

A student will be declared eligible for the award of B. Tech. degree if he/she fulfills the following:

(a) Pursues a course of study in not less than four and not more than eight academic years for regular students. For LES students, pursue a course of study for not less than three academic years and not more than six academic years counted from the academic year of admission.

(b) He/she shall forfeit their seat in B. Tech course and their admission stands cancelled after eight academic years for regular students and six academic years for LES students starting from the academic year of admission.

(c) Registers for 160 credits and must secure all the 160 credits for Regular students. Registers for 121 credits and must secure all the 121 credits for LES students

(d) A student shall be eligible for the award of B.Tech degree with Honors or Minor if he/she earns 20 credits in addition to the 160/121 credits and meet other specified requirements in the appropriate section of this document.

(e) A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.

Academic Calendar

For all the eight/six semesters a common academic calendar shall be followed in each semester by having sixteen weeks of instruction, one week for the conduct of practical exams and with two weeks for theory examinations. Dates for registration, sessional and end semester examinations shall be notified in the academic calendar of every semester. The schedule for the conduct of all the curricular and co-curricular activities shall be notified in the planner.

4. Assigning of Credits:

1 Hr. Lecture (L) per week - 1 credit

1 Hr. Tutorial (T) per week - 1 credit

1 Hr. Practical (P) per week - 0.5 credits

2 Hours Practical (Lab)/week - 1 credit

5. Induction Program

When new students enter an institution, they come with diverse thoughts, backgrounds and preparations. It is important to help them adjust to the new environment and inculcate in them the ethos of the institution with a sense of larger purpose. Its purpose is to make the students feel comfortable in their new environment, open them up, set a healthy daily routine, create bonding in the batch as well as between faculty and students, develop awareness, sensitivity and understanding of the self, people around them, society at large, and nature.

A three-week induction program for first year B.Tech students is to be held in zero semester. Regular classes will start after the induction program.

The objectives of the program are as follows:

1. Assimilation in the ethos and culture of the institution
2. Exposure to a larger vision of life
3. Bonding among students and teachers
4. Learning a creative skill in arts
5. Regular lifestyle and professional discipline
6. Special assistance for needy students for improving proficiency in English and Mathematics

The above objectives will be achieved through the following activities:

1. Physical activity: Yoga, Mild Exercise, Games and sports etc.
2. Creative arts: Painting, Photography, music, dance etc.
3. Literary activity: General reading, writing summaries, debating, enacting a play etc.
4. Human Values: Discussion/Lectures in small groups of students with a faculty member
5. Lectures by eminent people: From industry, entrepreneurs, public life, social activists, alumni.
6. Exposure to department/branch, Innovation, Exploring Engineering.

6. DISTRIBUTION AND WEIGHTAGE OF MARKS

The performance of a student in each semester shall be evaluated subject – wise with a maximum of 100 marks for Theory and 50 marks for Mini Project/Practical Training/Internship/ Research Project/ Community Service Project. The Project Work shall be evaluated for 200 marks.

THEORY

For all theory subjects consisting of 5 units of syllabus in each subject, the assessment shall be for 30 marks through internal evaluation and 70 marks through external end semester examination of 3 hours duration.

INTERNAL EVALUATION

Internal evaluation is based on two **Cycles** of **examinations**. Each **Cycle** consists of three components.

1) **Assignment Test – 1 (A1)**:

   A1 will be conducted after the completion of 1st unit of syllabus. 5 or 6 questions will be given to students before 1 week of the commencement of the test. On the day of the test, each student will be given two questions at random. A1 will be evaluated for 05 marks.

2) **Quiz - 1(Q1)**:

After the completion of the first two and half Units of syllabus (first half of the syllabus), along with the descriptive test, an online quiz test will be conducted for 20 marks and scaled down to 10 marks.

3) **Descriptive Test – 1(D1)**:

Along with the Q1, a descriptive test will be conducted for 25 marks and scaled down to 15 marks. Two 10 marks questions from each of Unit-1 & Unit-2, and one 5 marks question from the first half of 3rd unit will be given.

Cycle–I final marks = A1 (05 marks) + Q1 (10 marks) + D1 (15 marks) = 30 marks

In the similar manner, Cycle–II Examination will be conducted as follows:

A2 test will be conducted after 3.5 units of syllabus (covering syllabus from 2.5 to 3.5 units)

After the completion of the 5th unit of Syllabus, Q2 and D2 will be conducted. For D2, one 5 marks question will be given from the second half of the third unit, two 10 marks questions will be given each from units 4 and 5.

Cycle–II final marks = A2 + Q2 + D2 = 30 Marks.

Final internal marks will be computed as **80 % of best cycle marks + 20% of least cycle marks.**

EXTERNAL EVALUATION

The semester end examinations will be conducted for 70 marks consisting of five questions carrying 14 marks each. Students have to answer all the questions. One question from each of the 5 units and may contain sub-questions. For each question there will be an "either" "or" choice, which means that there will be two questions from each unit and the student should answer either of the two questions.

PRACTICALS

INTERNAL EVALUATION

For practical subjects there shall be continuous evaluation during the semester for 15 internal marks and 35 end examination marks. The internal 15 marks shall be awarded as follows:

Day to day work - 5 marks,

Record-5 marks and

Internal laboratory test -5 marks.

EXTERNAL EVALUATION

For practical subjects there shall be an external examination at the end of the semester for 35 marks in the presence of an external examiner. The examination duration is 3 hours.

DRAWING SUBJECTS

For the subject having design and / or drawing, (such as Engineering Graphics, Engineering Drawing, Machine Drawing etc.,) and estimation, the distribution shall be 30 marks for Internal Evaluation and 70 marks for End Examination. There shall be two internal tests in a semester.

The 30 internal marks will be evaluated as follows:

Cycle–I:
Internal Test : 15 marks. (1½ hour duration)
Day – to – day work: 15 marks (evaluation of charts)

In the Similar manner, **Cycle–II examination will be conducted for 30 marks**
The sum of 80% of the best and 20% of the least of two internal tests shall be considered.

Mandatory Course (M.C): Environmental Sciences/NSS/NCC, Universal Human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge etc non-credit (zero credits) mandatory courses. Environmental Sciences shall be offered compulsorily as mandatory course for all branches. A minimum of 75% attendance is mandatory in these subjects. There shall be an external examination for 70 marks and it shall be conducted by the college internally. Two internal examinations shall be conducted for 30 marks and a student has to secure at least 40% of the marks for passing the course. There is no online internal exam for mandatory courses. No marks or letter grade shall be printed in the transcripts for all mandatory non-credit courses, but only SATISFACTORY(S)/NOT-SATISFACTORY (F) will be specified.

- There shall be 05 Professional Elective courses and 04 Open Elective courses. All the Professional & Open Elective courses shall be offered for 03 credits, wherever lab component is involved it shall be (2-0-2) and without lab component it shall be (3-0-0) or (2-1-0) and for all minors /honors, it shall be (4-0-0). If a course comes with a lab component, that component has to be cleared separately. The concerned BOS shall explore the possibility of introducing virtual labs for such courses with lab component.

- All Open Electives are offered to students of all branches in general. However, a student shall choose an open Elective from the list in such a manner that he/she has not studied the same course in any form during the Programme.

- The college shall invite registration forms from the students at the beginning of the semester for offering professional and open elective courses. There shall be a limit on the minimum and maximum number of registrations based on class/section strength.

- Students shall undergo mandatory summer Internship/Community Service Project for a minimum of 4 to 8 weeks duration at the end of second and third year of the Programme.

- There shall be 05 skill-oriented courses offered during III to VII semesters. Among the five skill courses, four courses shall focus on the basic and advanced skills related to the domain courses and the remaining one shall be a soft skills course.

- Undergraduate Degree with Honors/Minor shall be issued by the Institute to the students who fulfill all the academic eligibility requirements for the B.Tech program and Honors/Minor program. The objective is to provide additional learning opportunities to academically motivated students. The regulations/guidelines are separately provided. Registering for Honors/Minor is optional.

- **Assessment:** The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory, 50 marks for practical subject. The distribution shall be 30% marks for Internal Evaluation and 70% marks for the End Semester Examinations. A student has to secure not less than 35% of marks in the end semester examination and minimum 40% of marks in the sum total of internal and end semester examination marks to earn the credits allotted to each course.

Internship/ Community Service Project (1.5 Credits):

It shall be completed in collaboration with local industries, Govt. Organizations, construction agencies, Industries, Hydal and thermal power projects and also in software MNCs in the area of concerned specialization of the UG programme.

Students shall pursue this course during summer vacation just before its offering as per course structure. The minimum duration of this course is at least 4 to 8 weeks. The student shall register for the course as per course structure after commencement of academic year. A supervisor/mentor/advisor

has to be allotted from the institute to guide the students for taking up the summer internship. The supervisor shall monitor the attendance of the students while taking up the internship. After successful completion, students shall submit a summer internship technical report to the concerned department and appear for an oral presentation before the departmental committee consists of an external examiner; Head of the Department; supervisor of the internship and a senior faculty member of the department.

A certificate from industry/skill development center shall be included in the report. The report and the oral presentation shall carry 40% and 60% weightages respectively. It shall be evaluated for 50 external marks at the end of the semester. A student shall secure a minimum 40% of marks for successful completion. In case, if a student fails, he/she shall reappear as and when semester supplementary examinations are conducted.

Internship/Community Service Project will be evaluated at the end of the semester for 50 marks (Record/Report: 20 marks and viva-voce: 30 marks) along with laboratory end examinations in the presence of external and internal examiner. There are no internal marks for the Internship/Community Service Project.

Major Project **(12 credits):**

Evaluation: The total marks for project work 200 marks and distribution shall be 60 marks for internal and 140 marks for external evaluation. The supervisor assesses the student for 30 marks (Report: 15 marks, Seminar: 15 marks). At the end of the semester, all projects shall be showcased at the department for the benefit of all students and staff and the same is to be evaluated by the departmental Project Review Committee consisting of supervisor, a senior faculty and HOD for 30 marks. The external evaluation of Project Work is a Viva-Voce Examination conducted in the presence of internal examiner and external examiner and is evaluated for 140 marks.

MOOCS (1.5 Credits):

Meeting with the global requirements, to inculcate the habit of self-learning and in compliance with AICTE/ UGC guidelines, MOOC (Massive Open Online Course) have been introduced. Students have to complete an on-line course to fulfill the academic requirement of B.Tech course. Students can start registering for the course from II Year I semester. The student must register for the MOOCs course as per the academic credit requirements mentioned in the Course structure offered by NPTEL with the approval of the Head of the Department. The student will be awarded the credits given in the curriculum only after the submission of the certificate. Students must submit the NPTEL Pass certificate with required credits before the end of 3rd Year 2nd Semester.

In case the student is unable to submit an NPTEL certificate with required credits by the end of 3rd Year 2nd Semester, the student is required to submit 2 MOOCs Certificates from the reputed

organizations approved by the concerned HOD before the commencement of 4th Year 1st Semester examinations.

Skill Oriented Courses (2 Credits)

1. For skill oriented/skill advanced course, one theory and 2 practical hours or two theory hours may be allotted as per the decision of concerned BOS.
2. Out of the five skill courses two shall be skill-oriented courses from the same domain and shall be completed in second year. Of the remaining 3 skill courses, one shall be necessarily be a soft skill course and the remaining 2 shall be skill-advanced courses either from the same domain or Job oriented skill courses, which can be of inter disciplinary nature.
3. A pool of interdisciplinary job-oriented skill courses shall be designed by a common Board of studies by the participating departments/disciplines and the syllabus along with the pre requisites shall be prepared for each of the laboratory infrastructure requirements.
4. The student shall be given an option to choose either the skill courses being offered by the college or to choose a certificate course being offered by industries/Professional bodies/APSSDC or any other accredited bodies as approved by the departmental committee.
5. The Board of Studies of the concerned discipline of Engineering shall review the skill advanced courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest courses based on industrial demand.
6. If a student chooses to take a Certificate Course offered by industries/Professional bodies/APSSDC or any other accredited bodies, in lieu of the skill advanced course offered by the Department, the credits shall be awarded to the student upon producing the Course Completion Certificate from the agency/professional bodies as approved by the departmental committee.

Evaluation: The job oriented skill courses may be registered at the college or at any accredited external agency as approved by departmental committee. A student shall submit a record/report on the on the skills learned. If the student completes job oriented skill course at external agency, a certificate from the agency shall be included in the report. The course will be evaluated at the end of the semester for 50 marks (record: 15 marks and viva-voce: 35 marks) along with laboratory end examinations in the presence of external and internal examiner. There are no internal marks for the job oriented skill courses.

Curricular Framework for Honors Programme

1. Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.
2. A student shall be permitted to register for Honors program at the beginning of 4^{th} semester provided that the student must have acquired a minimum of 8.0 SGPA upto the end of 2^{nd} semester without any backlogs. In case of the declaration of the 3^{rd} semester results after the commencement of the 4^{th} semester and if a student fails to score the required minimum of 8 SGPA, his/her registration for Honors Programme stands cancelled and he/she shall continue with the regular Programme. An SGPA of 8 has to be maintained in the subsequent semesters without any backlog in order to keep the Honors Programme registration active.
3. Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.
4. In addition to fulfilling all the requisites of a Regular B.Tech Programme, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).
5. 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 8/12weeks as recommended by the Departmental committee.
6. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.
7. The concerned departmental committee shall decide on the minimum enrolments for offering Honors program by the department. 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 departmental committee. MOOC courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Students have to acquire a certificate from the agencies approved by the departmental committee. with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned as per the guidelines approved by the departmental committee. .
8. The concerned BoS shall also consider courses listed under professional electives of the respective B. Tech programs for the requirements of B. Tech (Honors). However, a student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

9. If a student drops or is terminated from the Honors program, the additional credits so far earned cannot be converted into free or core electives; they will remain extra. These additional courses will be mentioned in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.
10. In case a student fails to meet the SGPA requirement for Degree with Honors at any point after registration, he/she will be dropped from the list of students eligible for Degree with Honors and they will receive regular B.Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.
11. Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor's degree.

Curricular Framework for Minor Programme:

1. a) Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering

b) Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.

2. The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE,CE,ME etc or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, Robotics, VLSI etc.
3. The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.
4. There shall be no limit on the number of programs offered under Minor. The Institution can offer minor programs in emerging technologies based on expertise in the respective departments or can explore the possibility of collaborating with the relevant industries/agencies in offering the program.
5. The concerned BoS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to

register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.

6. A student shall be permitted to register for Minors program at the beginning of 4^{th} semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA (Semester Grade point average) upto the end of 2^{nd} semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4^{th} semester. If a student fails to acquire 8 SGPA upto 3^{rd} semester or failed in any of the courses, his registration for Minors program shall stand cancelled. An SGPA of 8 has to be maintained in the subsequent semesters without any backlog in order to keep the Minors registration active.

7. A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e. 160 credits).

8. Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Programme.

9. In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits.

10. Student can opt for the Industry relevant minor specialization as approved by the concerned Departmental committee. Students can opt the courses from Skill Development Corporation (APSSDC) or can opt the courses from an external agency recommended and approved by concerned BOS and should produce a course completion certificate. The Departmental committee of the concerned discipline of Engineering shall review such courses being offered by eligible external agencies and prepare a fresh list every year incorporating latest skills based on industrial demand.

11. A committee should be formed at the level of the College/department to evaluate the grades/marks given by external agencies to a student which are approved by the concerned Departmental committee. Upon completion of courses the departmental committee should convert the obtained grades/marks to the maximum marks assigned to that course. The controller of examinations can take a decision on such conversions and may give appropriate grades.

12. If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in

the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript.

13. In case a student fails to meet the SGPA requirement for B.Tech degree with Minor at any point after registration, he/she will be dropped from the list of students eligible for degree with Minors and they will receive B. Tech degree only. However, such students will receive a separate grade sheet mentioning the additional courses completed by them.

14. Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he/she has already earned bachelor's degree.

PASS MARK CRITERIA

A student shall be deemed to have satisfied the pass mark, if he secures not less than 35% of marks in the end examinations and a minimum of 40% of marks in the sum total of the internal evaluation and end examination taken together as detailed below.

On passing a course of a program, the student shall earn the credits as assigned to that course.

S.No	Category of Subject	Max. Marks	Internal Marks	External Marks	External pass %	External pass mark	Over all pass %	Over all pass mark
1	Theory/ Drawing	100	30	70	35	25	40	40
2	Practical	50	15	35	35	12	40	20
3	Internship/Skill development courses/Community service project	50	-	50	40%	20	40	20
4	Project Work	200	60	140	35	49	40	80
5	MOOCs(Credit Course)	Certificate must be submitted before the end semester examinations of that semester in which MOOCS course is offered.						

11. Attendance Requirements:

a) A student is eligible to write the end semester examinations if he acquires a minimum of 40% in each subject and 75% of attendance in aggregate of all the subjects.

b) Condonation of shortage of attendance in aggregate up to 10% (65% and above, and below 75%) may be granted by the College Academic Committee. However, this condonation concession is applicable only to any two semesters during the entire programme.

c) Shortage of Attendance below 65% in aggregate shall not be condoned.

d) A student who is short of attendance in a semester may seek re-admission into that semester when offered within 4 weeks from the date of commencement of class work.

e) Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class.

f) A stipulated fee shall be payable towards condonation of shortage of attendance to the college. Students availing condonation on medical ground shall produce a medical certificate issued by the competent authority.

g) A student will be promoted to the next semester if he satisfies the (i) attendance requirement of the present semester and (ii) minimum required credits.

h) If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.

i) For induction programme attendance shall be maintained as per AICTE norms.

j) For non-credit mandatory courses the students shall maintain the attendance similar to credit courses

18. Promotion Rules:

a) A student shall be promoted from first year to second year if he fulfills the minimum attendance requirements.

b) A student will be promoted from II year to III year if he fulfills the academic requirement of 40% of credits up to II year II-Semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in II year II semester.

c) A student shall be promoted from III year to IV year if he fulfills the academic requirements of 40% of the credits up to III year II semester from all the examinations, whether or not the candidate takes the examinations and secures prescribed minimum attendance in III year II semester.

d) For LES, point C is only applicable

19. Grading:

After each subject is evaluated for 100 marks, the marks obtained in each subject will be converted to a corresponding letter grade as given below, depending on the range in which the marks obtained by the student fall.

Marks Range	Level	Letter Grade	Grade Point
≥ 90	Outstanding	A+	10
80-89	Excellent	A	9
70-79	Very Good	B	8

60-69	Good	C	7
50-59	Fair	D	6
40-49	Satisfactory	E	5
< 40	Fail	F	0
-	Absent	AB	-
-	Malpractice	MP	-

Calculation of Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

i. The Semester Grade Point Average (SGPA) is the ratio of sum of the product of the number of credits with the grade points scored by a student in all the courses taken by a student and the sum of the number of credits of all the courses undergone by a student, i.e.

$$SGPA = \Sigma (C_i \times G_i) / \Sigma C_i$$

Where, C_i is the number of credits of the i^{th} subject and G_i is the grade point scored by the student in the i^{th} course.

ii. The Cumulative Grade Point Average (CGPA) will be computed in the same manner taking into account all the courses undergone by a student over all the semesters of a program, i.e.

$$CGPA = \Sigma (C_i \times S_i) / \Sigma C_i$$

Where 'Si' is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester

iii. Both SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

iv. SGPA & CGPA will be calculated for those candidates who have passed all the subjects in that or up to that semester respectively.

v. *Grade Point:* It is a numerical weight allotted to each letter grade on a 10-point scale.

vi. *Letter Grade:* It is an index of the performance of students in a said course. Grades are denoted by letters A+, A, B, C, D, E and F.

vii. As per AICTE regulations, conversion of CGPA into equivalent percentage as follows:

Equivalent Percentage = (CGPA – 0.75) x 10

Award of Class:

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of B. Tech. degree, he/she shall be placed in one of the following:

Class Awarded	CGPA Secured
First Class with Distinction	≥ 7.75 (With No subject failures)
First Class	≥ 6.75 (With subject failures)
Second Class	≥ 5.75 & < 6.75
Pass Class	≥ 5.0 & < 5.75

20. Gap - Year:

Gap Year – concept of Student Entrepreneur in Residence shall be introduced and outstanding students who wish to pursue entrepreneurship are allowed to take a break of one year at any time after I year/II year/III year to pursue entrepreneurship full time. This period shall be counted for the maximum time for graduation. An evaluation committee at institute level shall be constituted to evaluate the proposal submitted by the student and the committee shall decide on permitting the student for availing the Gap Year.

REVALUATION

1. Students can submit the application for revaluation, along with the prescribed fee for revaluation of his answer script(s) of theory subject(s) as per the notification issued by the Controller of Examinations.
2. The Controller of Examinations shall arrange for revaluation of such answer script(s).
3. An evaluator, other than the first evaluator shall revaluate the answer script(s).

SUPPLEMENTARY EXAMINATIONS: A student who has failed to secure the required credits can appear for a supplementary examination, as per schedule announced by the College authorities.

MALPRACTICE IN EXAMINATIONS: Disciplinary action will be taken in case of malpractice during Mid/End examinations as per the rules framed by the College.

MINIMUM INSTRUCTION DAYS

The minimum instruction days for each semester shall be 90 working days.

There shall be no branch transfer after the completion of the admission process.

WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the college or if any case of indiscipline is pending against him, the result of such a student will be kept withheld. His degree will be withheld in such cases.

TRANSITORY REGULATIONS

Discontinued or detained candidates are eligible for readmission as and when next offered. A candidate, who is detained or discontinued in a semester, on readmission shall be required to do all the subjects in the curriculum prescribed for the batch of students in which the student joins subsequently. However, exemption will be given to those candidates who have already passed such subjects in the earlier semester(s) he was originally admitted into and substitute subjects are offered in place of them as decided by the Board of Studies. However, the decision of the Board of Studies will be final.

A student who is following JNTUK curriculum and detained due to shortage of attendance at the end of the first semester of first year shall join the autonomous batch of first year first semester. Such students shall study all the subjects prescribed for the batch in which the student joins and considered on par with regular candidates of Autonomous stream and will be governed by the autonomous regulations.

A student who is following JNTUK curriculum, detained due to lack of credits or shortage of attendance at the end of the second semester of first year or at the subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects will be offered in place of them as decided by the Board of Studies. The student has to clear all his backlog subjects up to previous semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree will be sum of the credits up to previous semester under JNTUK regulations and the credits prescribed for the semester in which a candidate seeks readmission and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

Transfer candidates (from non-autonomous college affiliated to JNTUK)

A student who is following JNTUK curriculum, transferred from other college to this college in second year first semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree. However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in their place as decided by the Board of Studies. The student has to clear all his backlog subjects up to previous semester by appearing for the supplementary examinations conducted by JNTUK for the award of degree. The total number of credits to be secured for the award of the degree will be the sum of the credits up to previous semester under JNTUK regulations and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

Transfer candidates (from an autonomous college affiliated to JNTUK)

A student who has secured the required credits up to previous semester as per the regulations of other autonomous institutions shall also be permitted to be transferred to this college.

A student who is transferred from the other autonomous colleges to this college in second year first semester or subsequent semesters shall join with the autonomous batch in the appropriate semester. Such candidates shall be required to pass in all the subjects in the program prescribed by the Board of Studies concerned for that batch of students from that semester onwards to be eligible for the award of degree.

However, exemption will be given in the subjects of the semester(s) of the batch which he had passed earlier and substitute subjects are offered in their place as decided by the Board of studies.

The total number of credits to be secured for the award of the degree will be the sum of the credits up to previous semester as per the regulations of the college from which he has transferred and the credits prescribed for the semester in which a candidate joined after transfer and subsequent semesters under the autonomous stream. The class will be awarded based on the academic performance of a student in the autonomous pattern.

Scope

1. The academic regulations should be read as a whole, for the purpose of any interpretation.
2. In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council is final.

3. The college may change or amend the academic regulations, course structure or syllabi at any time, and the changes or amendments made shall be applicable to all students with effect from the date notified by the College Authorities.

MALPRACTICES RULES

DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

➢ The Principal shall refer the cases of Malpractices in Internal Assessment Test and Semester end examinations to a malpractice prevention committee constituted by him for the purpose. Such committee shall follow the approved levels of punishment. The Principal shall take necessary action against the students based on the recommendations of the committee.

➢ Any action by the candidate trying to get undue advantage in the performance or trying to help another, or derive the same through unfair means is punishable according to the provisions contained hereunder:

	Nature of Malpractices/ Improper conduct	**Punishment**
	If the candidate:	
1(a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination).	Expulsion from the examination hall and cancellation of the performance in that subject only.
1(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester/year. The Hall Ticket

		of the candidate is to be cancelled and sent to the college.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate, who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and to be allowed to appear for examinations of the remaining subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant – Superintendent /any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates also are debarred and forfeit their seats. In case of

	examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the college campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all college examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges	Student of the college expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared

	in any malpractice or improper conduct mentioned in clause 6to 8.	including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the college will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester/year.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester/year examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the college for further action to award suitable punishment.	

OTHER MATTERS:

1. Physically challenged candidates who have availed additional examination time and a scribe during their intermediate / EAMCET examinations will be given similar concessions on production of relevant proof / documents.
2. The Principal shall deal in an appropriate manner with any academic problem which is not covered under these rules and regulations, in consultation with the Heads of the departments and subsequently such actions shall be placed before the Academic Council for ratification. Any emergency modification of regulation, approved in the meetings of the Heads of the departments shall be reported to the Academic Council for ratification.

GENERAL:

1. The academic council may, from time to time, revise, amend or change the regulations, schemes of examinations and / or syllabi.
2. Where ever the words ‘’he’’ ‘’him’’ ‘’his’’, occur in the regulations, they include ‘’she’’, ’’her’’, ’’hers’’.
3. The academic regulation should be read as a whole for the purpose of any interpretation.
4. In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Principal is final.

ANNEXURE-I

COMMUNITY SERVICE PROJECT

……Experiential learning through community engagement

As per the decision of the concerned department BoS

Introduction

- Community Service Project is an experiential learning strategy that integrates meaningful community service with instruction, participation, learning and community development
- Community Service Project involves students in community development and service activities and applies the experience to personal and academic development.
- Community Service Project is meant to link the community with the college for mutual benefit. The community will be benefited with the focused contribution of the college students for the village/ local development. The college finds an opportunity to develop social sensibility and responsibility among students and also emerge as a socially responsible institution.

Objective

Community Service Project should be an integral part of the curriculum, as an alternative to the 4 to 8 weeks of Summer Internships / Apprenticeships / On the Job Training, whenever there is an exigency when students cannot pursue their summer internships. The specific objectives are;

- To sensitize the students to the living conditions of the people who are around them,
- To help students to realize the stark realities of the society.
- To bring about an attitudinal change in the students and help them to develop societal consciousness, sensibility, responsibility and accountability
- To make students aware of their inner strength and help them to find new /out of box solutions to the social problems.
- To make students socially responsible citizens who are sensitive to the needs of the disadvantaged sections.
- To help students to initiate developmental activities in the community in coordination with public and government authorities.
- To develop a holistic life perspective among the students by making them study culture, traditions, habits, lifestyles, resource utilization, wastages and its management, social problems, public administration system and the roles and responsibilities of different persons across different social systems.

Implementation of Community Service Project

- Every student should put in a minimum of **180 hours** for the Community Service Project during the summer vacation.
- Each class/section should be assigned with a mentor.

- Specific Departments could concentrate on their major areas of concern. For example, Dept. of Computer Science can take up activities related to Computer Literacy to different sections of people like - youth, women, house-wives, etc
- A log book has to be maintained by each of the student, where the activities undertaken/involved to be recorded.
- The log book has to be countersigned by the concerned mentor/faculty incharge.

- Evaluation to be done based on the active participation of the student and grade could be awarded by the mentor/faculty member.
- The final evaluation to be reflected in the grade memo of the student.

- TheCommunity Service Project should be different from the regular programmes of NSS/NCC/Green Corps/Red Ribbon Club, etc.
- Minor project report should be submitted by each student. An internal Viva shall also be conducted by a committee constituted by the principal of the college.
- Award of marks shall be made as per the guidelines of Internship/apprentice/ on the job training

Procedure

- A group of students or even a single student could be assigned for a particular habitation or village or municipal ward, as far as possible, in the near vicinity of their place of stay, so as to enable them to commute from their residence and return back by evening or so.

- The Community Service Project is a twofold one –
    - First, the student/s could conduct a survey of the habitation, if necessary, in terms of their own domain or subject area. Or it can even be a general survey, incorporating all the different areas. A common survey format could be designed. This should not be viewed as a duplication of work by the Village or Ward volunteers, rather, it could be another primary source of data.
    - Secondly, the student/s could take up a social activity, concerning their domain or subject area. The different areas, could be like –
        - Agriculture
        - Health
        - Marketing and Cooperation
        - Animal Husbandry
        - Horticulture
        - Fisheries
        - Sericulture
        - Revenue and Survey

- Natural Disaster Management
- Irrigation
- Law & Order
- Excise and Prohibition
- Mines and Geology
- Energy
- Internet
- Free Electricity
- Drinking Water

EXPECTED OUTCOMES

BENEFITS OF COMMUNITY SERVICE PROJECT TO STUDENTS

Learning Outcomes

- Positive impact on students' academic learning
- Improves students' ability to apply what they have learned in "the real world"
- Positive impact on academic outcomes such as demonstrated complexity of understanding, problem analysis, problem-solving, critical thinking, and cognitive development
- Improved ability to understand complexity and ambiguity

Personal Outcomes

- Greater sense of personal efficacy, personal identity, spiritual growth, and moral development
- Greater interpersonal development, particularly the ability to work well with others, and build leadership and communication skills

Social Outcomes

- Reduced stereotypes and greater inter-cultural understanding
- Improved social responsibility and citizenship skills
- Greater involvement in community service after graduation

Career Development

- Connections with professionals and community members for learning and career opportunities
- Greater academic learning, leadership skills, and personal efficacy can lead to greater opportunity

Relationship with the Institution

- Stronger relationships with faculty
- Greater satisfaction with college
- Improved graduation rates

BENEFITS OF COMMUNITY SERVICE PROJECT TO FACULTY MEMBERS

- Satisfaction with the quality of student learning
- New avenues for research and publication via new relationships between faculty and community
- Providing networking opportunities with engaged faculty in other disciplines or institutions

- A stronger commitment to one's research

BENEFITS OF COMMUNITY SERVICE PROJECT TO COLLEGES AND UNIVERSITIES

- Improved institutional commitment
- Improved student retention
- Enhanced community relations

BENEFITS OF COMMUNITY SERVICE PROJECT TO COMMUNITY

- Satisfaction with student participation
- Valuable human resources needed to achieve community goals
- New energy, enthusiasm and perspectives applied to community work
- Enhanced community-university relations.

SUGGESTIVE LIST OF PROGRAMMES UNDER COMMUNITY

SERVICE PROJECT

The following is the recommended list of projects for Engineering students. The lists are not exhaustive and open for additions, deletions and modifications. Colleges are expected to focus on specific local issues for this kind of projects. The students are expected to carry out these projects with involvement, commitment, responsibility and accountability. The mentors of a group of students should take the responsibility of motivating, facilitating, and guiding the students. They have to interact with local leadership and people and appraise the objectives and benefits of this kind of projects. The project reports shall be placed in the college website for reference. Systematic, Factual, methodical and honest reporting shall be ensured.

For Engineering Students

1. Water facilities and drinking water availability
2. Health and hygiene
3. Stress levels and coping mechanisms
4. Health intervention programmes
5. Horticulture
6. Herbal plants
7. Botanical survey
8. Zoological survey
9. Marine products
10. Aqua culture
11. Inland fisheries

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY: KAKINADA

KAKINADA-533003, Andhra Pradesh (India)

For Constituent Colleges and Affiliated Colleges of JNTUK

Ragging

Prohibition of ragging in educational institutions Act 26 of 1997

Salient Features

- Ragging within or outside any educational institution is prohibited.
- Ragging means doing an act which causes or is likely to cause Insult or Annoyance of Fear or Apprehension or Threat or Intimidation or outrage of modesty or Injury to a student

	Imprisonment upto		Fine Upto
Teasing, Embarrassing & Humiliation	6 Months	+	Rs. 1,000/-
Assaulting or Using Criminal force or Criminal intimidation	1 Year	+	Rs. 2,000/-
Wrongfully restraining or confining or causing hurt	2 Years	+	Rs. 5,000/-
Causing grievous hurt, kidnapping or Abducts or rape or committing unnatural offence	5 Years	+	Rs. 10,000/-
Causing death or abetting suicide	10 Months	+	Rs. 50,000/-

In Case of Emergency CALL TOLL FREE No. : 1800 - 425 - 1288

LET US MAKE JNTUK A RAGGING FREE UNIVERSITY

I B.TECH- I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Engineering Chemistry	R20CC1103	BS	30	70	100	3	0	0	3
2	Linear Algebra and Calculus	R20CC1102	BS	30	70	100	2	1	0	3
3	Technical and Communicative English-I	R20CC1101	HS	30	70	100	3	0	0	3
4	Engineering Mechanics	R20CC1107	ES	30	70	100	2	1	0	3
5	Problem Solving using Python	R20ME1106	ES	30	70	100	3	0	0	3
6	Soft skills and Communication Skills Lab-1	R20CC11L1	HS	15	35	50	0	0	3	1.5
7	Engineering Chemistry Lab	R20CC11L5	BS	15	35	50	0	0	3	1.5
8	Problem Solving using Python Lab	R20ME11L3	ES	15	35	50	0	0	3	1.5
									Total	**19.5**

I B.TECH – II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Differential Equations and Vector Calculus	R20CC1201	BS	30	70	100	2	1	0	3
2	Engineering Physics	R20CC1203	BS	30	70	100	3	0	0	3
3	Engineering Drawing	R20CC1207	ES	30	70	100	1	0	4	3
4	Elements of Electrical and Electronics Engg.	R20ME1214	ES	30	70	100	3	0	0	3
5	Material Science and Metallurgy	R20ME1211	ES	30	70	100	3	0	0	3
6	Elements of Electrical and Electronics Engg. Lab	R20CC12L7	ES	15	35	50	0	0	3	1.5
7	Engineering Physics Lab	R20CC12L5	BS	15	35	50	0	0	3	1.5
8	Engineering Workshop	R20CC12L4	ES	15	35	50	0	0	3	1.5
9	Constitution of India (MC)	R20CC12MC2	MC	-	-	-	2	0	0	0
									Total	**19.5**

II B.TECH – I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Numerical Methods and Transformations	R20CC2101	BS	30	70	100	2	1	0	3
2	Fluid Mechanics and Hydraulic Machinery	R20ME2102	PC	30	70	100	2	1	0	3
3	Metrology and Instrumentation	R20ME2103	PC	30	70	100	3	0	0	3
4	Thermodynamics	R20ME2104	PC	30	70	100	2	1	0	3
5	Mechanics of Solids	R20ME2105	PC	30	70	100	2	1	0	3
6	FMHM Lab	R20ME21L1	PC	15	35	50	0	0	3	1.5
7	MOS and Metallurgy Lab	R20ME21L2	PC	15	35	50	0	0	3	1.5
8	Metrology and Instrumentation Lab	R20ME21L3	PC	15	35	50	0	0	3	1.5
9	Solid Modelling	R20ME21SC1	SC	-	50	50	0	0	4	2
10	Environmental Studies	R20CC21MC1	MC	-	-	-	2	0	0	0
									Total	**21.5**

II B.TECH– II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Applied Thermodynamics	R20ME2204	ES	30	70	100	2	1	0	3
2	Complex Variables Probability and Statistics	R20CC2202	BS	30	70	100	2	1	0	3
3	Kinematics of Machinery	R20ME2205	PC	30	70	100	3	0	0	3
4	Manufacturing Technology	R20ME2203	PC	30	70	100	3	0	0	3
5	Technical and Communicative English –II	R20CC2201	HS	30	70	100	3	0	0	3
6	Machine Drawing Lab	R20ME22L1	PC	15	35	50	0	0	3	1.5
7	Applied Thermodynamics Lab	R20ME22L2	PC	15	35	50	0	0	3	1.5
8	Manufacturing Technology Lab	R20ME22L3	PC	15	35	50	0	0	3	1.5
9	Computer Aided Engineering Practice	R20ME22SC2	SC	-	50	50	0	0	4	2
									Total	**21.5**
10	Honors/Minors Course	-	HC	30	70	100	4	0	0	4

III B.TECH – I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Artificial Intelligence and Machine Learning	R20ME3101	PC	30	70	100	3	0	0	3
2	Heat Power Engineering	R20ME3102	PC	30	70	100	2	1	0	3
3	Design of Machine Elements-I	R20ME3103	PC	30	70	100	2	1	0	3
4	**Open Elective Course/Job Oriented Elective -I**		OE	30	70	100	3	0	0	3
	RPT &3D Printing (Other than ME)	R20CC1OE06								
	Operations Research	R20CC1OE07								
5	**Professional Elective Course -I**		PC	30	70	100	3	0	0	3
	Automobile Engineering	R20ME3105								
	Refrigeration & Air Conditioning	R20ME3106								
	Metal Cutting & Machine Tools	R20ME3107								
	Work Study	R20ME3108								
6	Artificial Intelligence and Machine Learning Lab	R20ME31L1	PC	15	35	50	0	0	3	1.5
7	Heat power Engineering Lab	R20ME31L2	PC	15	35	50	0	0	3	1.5
8	Robotics & 3D Printing Lab	R20ME31SC3	SC	-	50	50	0	0	4	2
9	PE&HV	R20CC31MC01	MC				2	0	0	0
10	Internship/ Community Service Project	R20CC31IN	SI	-	50	50	0	0	3	1.5
									Total	**21.5**
11	Honors / Minors Course	-	HC	30	70	100	4	0	0	4

III B.TECH – II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Design of Machine Elements-II	R20ME3201	PC	30	70	100	2	1	0	3
2	Heat Transfer	R20ME3202	PC	30	70	100	2	1	0	3
3	Dynamics of Machinery	R20ME3203	PC	30	70	100	2	1	0	3
4	**Professional Elective Course -II**		PE	30	70	100	3	0	0	3
	Advanced Mechanics of Solids	R20ME3204								
	Nonconventional Sources of energy	R20ME3205								
	Quality concepts in Design	R20ME3206								
	Robotics & Applications	R20ME3207								
5	**Open Elective Course/Job Oriented Elective - II**		OE	30	70	100	3	0	0	3
	Industrial Engineering & Management (Other than ME)	R20CC2OE05								
	Industrial Robotics (Other than ME)	R20CC2OE06								
6	Heat Transfer Lab	R20ME32L1	PC	15	35	50	0	0	3	1.5
7	Machine Tools & Machine Dynamics Lab	R20ME32L2	PC	15	35	50	0	0	3	1.5
8	Pneumatics & HVAC Lab	R20ME32L3	PC	15	35	50	0	0	3	1.5
9	English for Employability Skills	R20CC32SC1	SC	-	50	50	0	0	4	2
10	Essence of Indian Traditional Knowledge	R20CC32MC1	MC				2	0	0	0
									Total	**21.5**
11	Honors / Minors Course		HC	30	70	100	4	0	0	4

IV B.TECH – I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	**Professional Elective Course-III**		PE	30	70	100	3	0	0	3
	Digital Manufacturing	R20ME4102								
	Design for Manufacturing	R20ME4103								
	Power Plant Engineering	R20ME4104								
	Optimization Techniques	R20ME4105								
	Total Quality Management	R20ME4106								
2	**Professional Elective Course-IV**		PE	30	70	100	3	0	0	3
	Finite Element Method	R20ME4107								
	Experimental Stress Analysis	R20ME4108								
	Solar Energy Systems	R20ME4109								
	Big Data Analytics	R20ME4110								
	Automation in Manufacturing	R20ME4111								
3	**Professional Elective Course-V**		PE	30	70	100	3	0	0	3
	Industrial Engineering & Management	R20ME4112								
	Mechanical Vibrations	R20ME4113								
	Waste Heat Recovery Systems	R20ME4114								
	Production Planning and Control	R20ME4115								
	Electric & Hybrid Vehicles	R20ME4116								
4	**Open Elective Course/Job Oriented Elective –III**		OE	30	70	100	3	0	0	3
	Automotive Vehicles	R20CC3OE05								
	Nano Technology	R20CC3OE06								
5	**Open Elective Course/Job Oriented Elective -IV**		OE	30	70	100	3	0	0	3
	Pneumatics & Hydraulic Automation	R20CC4OE05								
	Mechatronics	R20CC4OE06								
6	**Humanity & Social Service Elective**		HSSE	30	70	100	3	0	0	3

	1. Business Management Concepts for Engineering	R20CC4101								
	2. Entrepreneurship & Innovation	R20CC4117								
7	Mechatronics &Simulation Lab	R20ME41SC4	SC	-	50	50	0	0	4	2
8	Internship/ Community Service Project	R20CC41IN	SI	-	50	50	0	0	0	1.5
9	MOOCS Course	R20CC41MC	MC				0	0	0	1.5
									Total	**23**
10	Honors / Minor Courses (MOOCS)		HC	30	70	100	4	0	0	4

IV B.TECH– II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Major Project & Internship	R20CC42PW	PR				0	0	0	**12**
						Total				**12**
						Credits Grand Total				**160**

LIST OF HONORS

1. **The subjects opted for Honors should be advanced type which are not covered in regular curriculum.**
2. **Students has to acquire 16 credits with minimum one subject from each pool.**
3. **Concerned BoS can add or delete the subjects as per the decision of the board.**
4. **Pre requisites to be defined by the board for each course.**
5. **Compulsory MOOC / NPTEL Courses for 04 credits (02 courses@ 2 credits each)**

POOL - 1
AUTOMOTIVE DESIGN

S. No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Automobile Engine Design	R20MEHN01	PC	30	70	100	4	0	0	4
2	Automotive Transmission	R20MEHN02	PC	30	70	100	4	0	0	4
3	Autotronics and Safety	R20MEHN03	PC	30	70	100	4	0	0	4
4	Alternative Energy Sources for Automobiles	R20MEHN04	PC	30	70	100	4	0	0	4

POOL-2
ROBOTICS AND MECHATRONICS

S. No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Robotics Modelling & Analysis	R20MEHN05	PC	30	70	100	4	0	0	4
2	Modelling and Analysis of Dynamic Systems	R20MEHN06	PC	30	70	100	4	0	0	4
3	Theory and Design of Control Systems	R20MEHN07	PC	30	70	100	4	0	0	4
4	Smart Materials for Mechatronic applications	R20MEHN08	PC	30	70	100	4	0	0	4

POOL- 3

PRODUCT DESIGN AND DEVELOPMENT

S. No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Advanced Mechanical Vibrations	R20MEHN09	PC	30	70	100	4	0	0	4
2	Product Design	R20MEHN10	PC	30	70	100	4	0	0	4
3	Flexible Manufacturing systems	R20MEHN11	PC	30	70	100	4	0	0	4
4	Rapid Prototyping	R20MEHN12	PC	30	70	100	4	0	0	4

POOL 4

THERMAL SCIENCE AND ENGINEERING

S. No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Advanced Thermodynamics	R20MEHN13	PC	30	70	100	4	0	0	4
2	Advanced Heat Transfer	R20MEHN14	PC	30	70	100	4	0	0	4
3	Gas turbines and Jet Propulsion	R20MEHN15	PC	30	70	100	4	0	0	4
4	Computational Fluid Dynamics	R20MEHN16	PC	30	70	100	4	0	0	4

LIST OF MINORS

(General Minor Track)

1. The student can opt any 4 subjects from each pool.

2. Concerned BoS can add or delete the subjects as per the decision of the board.

3. Pre requisites to be defined by the board for each course.

4. Compulsory MOOC/NPTEL Courses for 04 credits (02 courses@ 2 credits each)

S. No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Advanced Engineering Materials	R20CCMN13	PC	30	70	100	4	0	0	4
2	Power Plant Engineering	R20CCMN14	PC	30	70	100	4	0	0	4
3	Advanced Manufacturing Processes	R20CCMN15	PC	30	70	100	4	0	0	4
4	Innovative Product Design and Development	R20CCMN16	PC	30	70	100	4	0	0	4
5	Industrial Engineering	R20CCMN17	PC	30	70	100	4	0	0	4
6	3D Printing Technology	R20CCMN18	PC	30	70	100	4	0	0	4
7	Advanced Casting Technology	R20CCMN19	PC	30	70	100	4	0	0	4
8	Advanced Metal Joining Process	R20CCMN20	PC	30	70	100	4	0	0	4
9	Computer Integrated Manufacturing	R20CCMN21	PC	30	70	100	4	0	0	4
10	Expert System Manufacturing	R20CCMN22	PC	30	70	100	4	0	0	4
11	Additive Manufacturing	R20CCMN23	PC	30	70	100	4	0	0	4

I B.TECH- I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Engineering Chemistry	R20CC1103	BS	30	70	100	3	0	0	3
2	Linear Algebra and Calculus	R20CC1102	BS	30	70	100	2	1	0	3
3	Technical and Communicative English-I	R20CC1101	HS	30	70	100	3	0	0	3
4	Engineering Mechanics	R20CC1107	ES	30	70	100	2	1	0	3
5	Problem Solving using Python	R20ME1106	ES	30	70	100	3	0	0	3
6	Soft skills and Communication Skills Lab-1	R20CC11L1	HS	15	35	50	0	0	3	1.5
7	Engineering Chemistry Lab	R20CC11L5	BS	15	35	50	0	0	3	1.5
8	Problem Solving using Python Lab	R20ME11L3	ES	15	35	50	0	0	3	1.5
									Total	**19.5**

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: **R20CC1103**	**ENGINEERING CHEMISTRY (Common To All Branches)**						

COURSE OBJECTIVES:

- To analyze water for its various parameters and its significance in industrial and domestic allocations.
- To acquire the knowledge on types of polymers, fuels and their applications.
- To provide information on exciting advanced materials available in engineering.
- To apply the electrochemical principles, understand the fundamentals of corrosion and development of different techniques in corrosion control.
- To learn the importance of engineering materials used in daily life and industry.

COURSE OUTCOMES:

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

CO 1: Analyze the suitable method of water treatment depending on the quality treatment.
CO 2: Compare different types of polymers, fuels and their importance
CO 3: Utilize the advanced materials as engineering materials and apply them in domestic and industrial life
CO 4: Distinguish electrical energy sources and importance of corrosion science
CO 5: Identify different types of engineering materials and applications in engineering.

UNIT-I: WATER CHEMISTRY

Characteristics of water: Sources, Impurities–Hardness & its units–Industrial water characteristics–Softening of water by external treatment methods (Lime soda process, Zeolite and Ion exchange process)–Numerical problems on lime soda process–Desalination of brackish water (Reverse osmosis and Electrodialysis).

Water analysis techniques: Alkalinity–hardness (Complexo-metric)–Break point chlorination–Free chlorine–DO–BOD and COD.

UNIT-II: POLYMERS AND FUEL CHEMISTRY

Polymers: Introduction to polymers–Chain growth (free radical, ionic)–Step growth polymerization–Coordination polymerization–Copolymerization with specific examples–Thermoplastics and thermosets–Plastic moulding methods (Compression & Injection moulding)–Rubbers–Natural rubber–Processing–Vulcanization.

Fuels-Types of fuels–Calorific value–Numerical problems based on calorific value–Analysis of coal–Liquid fuels–Refining of petroleum–Cracking of heavy oil–Knocking and anti-knocking agents–Octane and cetane values.

UNIT-III: CHEMISTRY OF ADVANCED MATERIALS

Nano materials: Introduction–Sol-gel method & Chemical reduction method of preparation – Characterization by BET method and TEM methods–Carbon nano tubes and fullerenes: Types–Preparation–Properties and Applications.

Liquid crystals: Introduction–Types–Applications.

Composite materials: Introduction–Definition–Types–Applications–Cermets.

UNIT-IV: ELECTROCHEMISTRY AND CORROSION

Electrochemistry: Galvanic cells–Single electrode potential–Reference electrodes–Electrochemical series–Batteries (primary, secondary and fuel cells)–Applications of secondary batteries in E-vehicles.
Corrosion: Causes and effects of corrosion–Theories of corrosion (chemical and electrochemical corrosion)–Factors effecting corrosion–Corrosion control methods–Cathode protection–Sacrificial anodic, Impressed current methods–Surface coatings–Methods of application on metals (Hot dipping, Galvanizing, Tinning, Cladding, Electroplating, Electroless plating)–Organic surface coatings–Paints–Constituents and their functions–Pigment Volume Concentration.

UNIT-V: CHEMISTRY OF ENGINEERING MATERIALS
Lubricants: Introduction–Mechanism of lubrication–Classification of lubricants–Properties and testing of lubricating oils.
Cement & Refractories: Manufacture–Setting and hardening of cement–Failures of cement–Slag cement–Refractory: Introduction–Classification and properties of refractories.

TEXT BOOKS:

1. Shikha Agarwal, "Engineering Chemistry", ISBN 1107476410, 2nd Edition, Cambridge University Press, New Delhi, (2019).
2. O.G. Palana, "Engineering Chemistry", ISBN 0070146101, Tata McGraw Hill Education Private Limited, New Delhi, (2009).
3. B. Rama Devi, Ch. Venkata Ramana Reddy, Prashantharath, "Text Book of Engineering **Chemistry**", ISBN 9789353500511, Cenage Learning India Pvt. Ltd, (2016).

REFERENCE BOOKS:

1. P.C. Jain and M. Jain "Engineering Chemistry", ISBN 8187433175, 15/e, Dhanpat Rai & Sons, Delhi, (2015).
2. B.S Murthy and P. Shankar, "A Text Book of NanoScience and NanoTechnology", University Press (2013).
3. K. Sesha Maheshwaramma and Mridula Chugh, "Engineering Chemistry", Pearson India Edn services, (2016).
4. S.S. Dara, "A Textbook of Engineering Chemistry", ISBN 8121932645, S.Chand Publisher, (2010)

Web References:

1. URL: https://www.youtube.com/watch?v=CWOJW4357Bg
2. URL: https://www.youtube.com/watch?v=H1Y1oxQ5eUA&t=627s
3. URL: https://www.youtube.com/watch?v=1xWBPZnEJk8
4. URL: https://www.youtube.com/watch?v=p9yPXdT0k48&t=225s
5. URL: https://www.youtube.com/watch?v=xb_xndPe4n0&t=390s

E-Books:

1. "Engineering Chemistry" (NPTEL Web-book), by B.L. Tembe, Kamaluddin and M.S. Krishnan.

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20CC1102	**LINEAR ALGEBRA AND CALCULUS (Common to All Branches)**						

COURSE OBJECTIVES:

- Understanding basic concepts of linear algebra (systems of linear equations, matrix calculus).
- To become proficiency in solving computational problems of linear algebra.
- To acquire knowledge on mean value theorems in calculus.
- Familiarization about the techniques in calculus and multivariate analysis.

COURSE OUTCOMES:

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

CO1: Solve the system of linear equations.
CO2: Analyze the applications of matrices in various fields and obtain Eigen values and Eigenvectors.
CO3: Relate the results of mean value theorems in calculus to Engineering problems.
CO4: Apply the functions of several variables to evaluate the rates of change with respect to time and space variables in engineering.
CO5: Identify the area and volume by interlinking them to appropriate double and triple integrals.

UNIT-I: LINEAR SYSTEMS OF EQUATIONS:

Rank of a matrix - Echelon form, Normal form, Solution of linear systems, Direct Methods, Gauss elimination, Gauss Jordon and Gauss Seidal Methods. Solutions of linear simultaneous equations: LU decomposition.

Application: Finding the current in a electrical circuit, Traffic flow

UNIT – II: EIGENVALUES AND EIGENVECTORS

Eigenvalues, Eigenvectors, Properties, Cayley - Hamilton Theorem(without proof), Quadratic forms, Reduction of quadratic form to canonical form, Rank, Positive definite, negative definite, semi definite, index, signature.

Application: Finding powers and inverse of a square matrix using Cayley Hamilton's Theorem.

UNIT – III: MEAN VALUE THEOREMS

Review on limits and continuity, Mean Value theorems (without proofs): Rolle's Theorem, Lagrange's theorem, Cauchy's theorem, Taylor's (Generalized mean value) theorem, increasing and decreasing functions, Maxima and minima of function of single variable.

UNIT- IV: PARTIAL DIFFERENTION:

Function of two or more variables, Partial derivatives, Total derivatives, change of variables, Jacobian - functional dependence, Taylor's theorem for Two variables. Maxima and Minima of functions of two variables, Lagrange's method of undetermined multipliers.

UNIT-V: MULTIPLE INTEGRALS:

Double and triple integrals, Change of Variables, Change of order of Integration, volume.
Application: Momenta of Inertia.

TEXT BOOKS:

1. Dr. B.S. Grewal, "*Higher Engineering Mathematics*", 43rd Edition, Khanna Publishers, 2012.
2. B.V. Ramana, "Higher Engineering Mathematics", 32nd Edition, McGraw Hill Education, 2018.

REFERENCES:

1. N.P. Bali, Bhavanari Satyanarayana, Indrani Promod Kelkar, "*Engineering Mathematics*", University Science Press, (An Imprint of Lakshmi Publications Pvt., Ltd) New Delhi, 2012.
2. Kreyszig E, "*Advanced Engineering Mathematics*", 8th Edition, John Wiley, Singapore, 2001.
3. Greenberg M D, "*Advanced Engineering Mathematics*", 2nd Edition, Pearson Education, Singapore, Indian Print, 2003.
4. Peter V. O'Neil, *"Advanced Engineering Mathematics"*, 7th Edition, Cengage Learning, 2011.
5. Bhavanari Satyanarayana, Pradeep Kumar T.V. & Srinivasulu D, "Linear Algebra and Vector Calculus", Studera Press, New Delhi, 2017.

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC1101	**TECHNICAL AND COMMUNICATIVE ENGLISH-I (Common to All Branches)**						

COURSE OBJECTIVES:

- To enable the engineering students develop their basic communication skills in English for academic and social purposes.
- To equip the students with appropriate oral and written communication skills.
- To inculcate the skills of listening, reading and critical thinking.
- To integrate English Language learning with employability skills and training.
- To enhance the students' proficiency in reading skills enabling them meet the academic demands of their course.

COURSE OUTCOMES:

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

CO1: Infer explicit and implicit meaning of a text, recognize key passages; raise questions and summarize it.

CO2:Compose paragraphs, essays, emails, letters, reports, resume and transfer information into tables, Pie and bar diagrams.

CO3:Build grammatically correct sentences using a variety of sentence structures.

CO4:Enhance word power and usage of lexicons.

Teaching Methodology: The methodology of teaching will be chalk and talk, PPT, audio-visual, flipped class and activity based teaching.

UNIT-I

Hours of Instruction per unit: 8

1. A Drawer full of Happiness

a. **Listening** : Dialogues, Task based listening activities.
b**. Speaking** : Asking and answering general questions.
c. **Reading** : Skimming, Scanning.
d. **Writing** : Punctuations, Paragraphs.
e. **Grammar & Vocabulary** : Nouns, Adjuncts,
GRE Vocabulary,
Technical Vocabulary.

UNIT-II

Hours of Instruction per unit: 8

2. Nehru's Letter to daughter Indira on her Birthday

a. **Listening** : Individual and pair based listening to the audio track.
b**. Speaking** : Discussion in pairs / small groups on specific topics.
c. **Reading** : Identifying sequence of ideas; recognising verbal techniques.
d. **Writing** : Summarising, Paraphrasing.
e. **Grammar & Vocabulary** : Articles, Adjectives, Prepositions
Verbal Competence,
Synonyms & Antonyms,
Analogy,
GRE Vocabulary,
Technical Vocabulary.

UNIT-III

Hours of Instruction per unit: 8

3. Stephen Hawking- Positivity 'Benchmark'

a. **Listening** : Listening for global comprehension and summarising.

b**. Speaking** : Discussing specific topics in pairs (or) small groups and reporting the discussion, Complaining, Apologising.

c. **Reading** : Reading between the lines, Critical reading for evaluation.

d. **Writing** : Official Letter writing, E-Mail etiquette, General Netiquette, Covering Letter & Resume writing.

e. **Grammar & Vocabulary** : Phrasal verbs, Verbs, Tenses (Present, Past & Future), Concord: Subject-Verb Agreement, Verbal reason, Using equivalents, Word associations, GRE Vocabulary, Technical Vocabulary.

UNIT-IV

Hours of Instruction per unit: 8

4. Like a Tree, Unbowed: Wangari Maathai- Biography

a. **Listening** : Making predictions while listening to conversations (or) transactional dialogues.

b**. Speaking** : Role plays for practice of conversational English in academic contexts (formal and informal) .

c. **Reading** : Information transfer (Tables, Bar Diagrams, Line Graphs, Pie Diagrams)

d. **Writing** : Interpreting visual information, Statement of Purpose (SOP)

e. **Grammar & Vocabulary** : Gender inclusive language (Gendered Noun, Gender-neutral Noun), Quantifying expressions, Adjectives, Adverbs, Degrees of comparison, GRE Vocabulary, Technical Vocabulary.

UNIT-V

Hours of Instruction per unit: 8

5. "Stay Hungry, Stay Foolish"- Rushmi Bansal

a. **Listening** : Identifying key terms, understanding concepts, interpreting the concepts.

b**. Speaking** : Formal oral presentations on topics from academic contexts.

c. **Reading** : Reading comprehension, The RAP strategy for in-depth reading, Intensive reading and extensive reading.

d. **Writing** : Academic proposals, Poster presentation.

e. **Grammar & Vocabulary** : Reported Speech, Reporting verbs for academic purposes, Corrections of sentences, GRE Vocabulary, Technical Vocabulary.

TEXTBOOKS:

1. INFOTECH ENGLISH, Maruthi Publications, Guntur- 522001.

REFERENCES:

1. Raymond Murphy, *Murphy's English Grammar,* Cambridge University Press 2004
2. Meenakshi Raman, Sangeeta Sharma, *Technical Communication: English Skills for Engineers*, Oxford University Press, 2009
3. Michael Swan, *Practical English Usage*, Oxford University Press, 1996

Web References:

1. www.enchantedlearning.com
2. https://www.englisch-hilfen.de/en/
3. https://www.bbc.co.uk/learningenglish/
4. https://in.usembassy.gov/education-culture/american-spaces/american-space-new-delhi/collection/
5. https://www.talkenglish.com/speaking/basics/speaking_basics_ii.aspx
6. https://www.englishclub.com/speaking/
7. https://agendaweb.org/listening-exercises.html
8. https://www.esolcourses.com/content/topicsmenu/listening.html
9. https://www.esl-lab.com/
10. https://www.eagetutor.com/eage-fluent-english-speaking-search-p.htm?gclid=EAIaIQobChMIpr-F5OzH7QIVChsrCh1kBAkzEAMYASAAEgINpfD_BwE
11. https://www.myenglishpages.com/site_php_files/reading.php
12. https://www.cambridgeenglish.org/learning-english/free-resources/write-and-improve/

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20CC1107	**ENGINEERING MECHANICS (COMMON TO ME, CE BRANCHES)**						

COURSE OBJECTIVES:

- Learn and understanding the basic principles of mechanics of rigid bodies, various types of force systems and to analyze problems in a simple and logical manner.
- Study and calculate the concepts of wedge friction, and to analyze simple trusses using method of joints and method of sections.
- Study and determine centroids and center of gravity of various standard geometrical shapes as well as composite areas and bodies.
- Learn the concept of moment of inertia and the mathematical calculations involved in finding moments of inertia of two dimensional areas.
- The students are to be exposed to concepts of work, energy and particle motion.

COURSE OUTCOMES:

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

CO 1: Apply the principles of mechanics to determine the resultant of several concurrent forces acting on a particle.

CO 2: Analyze the trusses using method of joints and method of sections; apply the basic concepts of dry friction and wedges.

CO 3: Illustrate the centroid and center of gravity bodies and composite sections.

CO 4: Determine the Area Moment of Inertia and Mass Moment of Inertia of areas bodies and Composite sections.

CO 5: Apply the work-energy principle to particles and connected systems for engineering Applications.

Prerequisites: Vectors, Differential equations and integrations**.**

UNIT–I

INTRODUCTION TO ENGINEERING MECHANICS: Basic Concepts, Characteristics of a Force, Force system, classification, Resultant of Force Systems, parallelogram law of forces, Triangle law of forces.

SYSTEMS OF FORCES: Resolution of forces, Coplanar Concurrent forces, Moment of Force and its Application–Couples, Varignon's theorem.

EQUILIBRIUM OF SYSTEMS OF FORCES: Equations of Equilibrium of Coplanar concurrent forces, Lami's Theorem, support reactions, free body diagrams.

UNIT–II

ANALYSIS OF PLANE TRUSSES: Definition, Assumptions made in the analysis of plane trusses-methods of joints and method of sections.

FRICTION: Introduction, Classification of friction, Laws of Friction, Coefficient of Friction, Angle of Friction, Angle of Repose, Motion of a body on an Inclined Plane, Ladder friction, Wedge friction.

UNIT–III

CENTROID: Centroids of simple figures (from basic principles)-Centroids of composite figures.

CENTRE OF GRAVITY: Centre of Gravity of simple body (from basic principles), Centre of gravity of composite bodies, pappu's theorem.

UNIT-IV

AREA MOMENTS OF INERTIA: Definition, Radius of gyration, Parallel axis theorem, perpendicular axis theorem, Moments of Inertia of composite figures, polar moment of Inertia.

MASS MOMENT OF INERTIA: Moment of Inertia of Rigid body-Moment of Inertia from basic principles-Slender bar, Rectangular Plate, Circular Plate, Moment of Inertia of 3D Bodies-Cone, Solid Cylinder.

UNIT-V

KINETICS: Analysis as a particle, Newton's laws of motion, D'Alembert's principle –simple applications-analysis as a rigid body in translation-fixed axis rotation-Simple applications.

WORK-ENERGY METHOD: Equations for Translation, work-Energy applications to particle motion, connected system-Impulse momentum method-simple applications

TEXT BOOKS:

1. Engineering Mechanics by S.Timoshenko & D.H.Young., 4th Edn - ,Mc Graw Hill publications.
2. Engineering Mechanics by S.S. Bhavikatti-New age publications
3. Engineering Mechanics Statics and Dynamics A.K.TAYAL Umesh publications.

REFERENCE BOOKS:

1. Engineering Mechanics by Fedinand . L. Singer , Harper –Collins.
2. Mechanicsof Materials (In Si Units) by Beer and Johnson, Tata McGraw-Hil.
3. Strengthof Materials (Mechanics of Materials) by James M.Gere and Barry J.Goodno, PWS-KENT Publishing Company, 1990
4. Strengthof Materials (Mechanics of Solids) by R.K. Rajput , S.Chand Publications.

Web References:

1. https://nptel.ac.in/courses/112103109/142.
2. https://nptel.ac.in/courses/112103109/113.
3. https://nptel.ac.in/courses/122104014/4

E-Books:

1. https://easyengineering.net/engineeringmechanicsbooks/

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME1106	**PROBLEM SOLVING USING PYTHON (OTHER THAN CSE)**						

COURSE OBJECTIVES:

- To teach problem solving through flow charting tool-Raptor.
- To elucidate problem solving through python programming language.
- To introduce function oriented programming paradigm through python.
- To train in development of solutions using modular concepts.

COURSE OUTCOMES:

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

CO 1: Outline the computer system concepts and the flowcharts using raptor to solve the given problems.

CO 2:. **S**ummarize the fundamental concepts of python programming.

CO 3: Interpret object oriented and event driven programming in python.

CO 4: Apply the suitable data structures to solve the real time situational problems.

UNIT-I

Introduction to computers: algorithms; modern computer systems: hardware architecture, data representation in computers, software and operating system.

Flowchart design though raptor: Flowchart symbols, input/output, assignment, operators, conditional if, repetition, function and sub charts.

UNIT-II

Introduction to python: Numbers, strings, variables, operators, expressions, statements, string Operations& Methods, math function calls, Input/output statements, conditional if, while and for loops.

UNIT-III

Functions: user defined functions, parameters to functions, recursive functions, and lambda function.

Event driven programming: Turtle graphics, Turtle bar chart, Widgets, key press events, mouse events, timer events.

UNIT-IV

Data structures: List- list methods & functions, Tuple-tuple methods & functions, Dictionaries-dictionary methods & functions, traversing dictionaries. Sets-methods & functions, Files.

UNIT-V

OOP: class, object, methods, constructors, inheritance, inheritance types polymorphism, operator overloading, abstract classes, exception handling.

TEXT BOOKS:

1. Fundamentals of Python: First Programs ,Kenneth Lambert
2. Allen B. Downey, "think python: how to think like a computer scientist",2nd edition, O'reilly, 2016

REFERENCE BOOKS:

1. Python programming: A modern approach, vamsi kurama,pearson.

2. Learning python, Mark Lutz, Orielly.
3. Core python programming, W.Chun, pearson.
4. Introduction to python, Kenneth A. Lambert, Cengage.

WEB RESOURCES:

1. https://raptor.martincarlisle.com/
2. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf
3. https://zhanxw.com/blog/wp-content/uploads/2013/03/BeautifulCode_2.pdf
4. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf
5. https://www.cse.msu.edu/~stockman/ITEC/Scratch/BGC2011Scratch-Rev1.pdf
6. https://nostarch.com/scratchplayground
7. http://fusecontent.education.vic.gov.au/9f79537a-66fc-4070-a5ce-e3aa315888a1/scratchreferenceguide14.pdf

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20CC11L1	**SOFT SKILLS AND COMMUNICATION SKILLS LAB -1 (Common to All Branches)**						

COURSE OBJECTIVES:

- To build confidence in the students to communicate effectively in English.
- To strengthen the oral communication skills to enable them to interact with the people in various social situations.
- To enable the learners improve pronunciation with the knowledge of phonetics.
- To provide exposure to students to soft skills like Goal Setting, Time Management, Interpersonal Skills, and Intra Personal Skills.

COURSE OUTCOMES:

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

CO1: Communicate effectively with good pronunciation, overcoming mother tongue influence in academic and professional environment.

CO 2: Listen and comprehend several accents of English Language

CO 3: Take part in various conversations/discourses using formal and informal expressions.

CO 4: Adapt soft skills successfully in personal and professional life.

UNIT– I

a. Introduction to Phonetics.
b. Listening - TEDx Talks (https://www.ted.com/talks/ashweetha_shetty_how-education-helped-me-rewrite-my-life?language-en#t-623369)
c. Self-Introduction

UNIT–II

a. Pronunciation Rules & Common Errors in Pronunciation.
b. Listening -TEDx Talks(https://www.youtube.com/watch?v=Dk20-E0yx_s)
c. Role Play

UNIT–III

a. Situational Dialogues (Inviting, Accepting and Declining Invitations)
b. Listening - TEDx Talks (https://www.youtube.com/watch?v=IgAnj6r1O48)
c. JAM

UNIT-IV

a. Situational Dialogues (Commands, Instructions and Requests)
b. Listening -TEDx Talks(https://youtu.be/SKvMxZ284AA)
c. Telephonic Etiquette.

UNIT-V

a. Time Management.
b. Goal Setting.
c. Interpersonal Skills & Intra personal skills.

TEXT BOOKS:

1. *"Strengthen Your Communication Skills",* Maruthi Publications, 2013.

REFERENCE BOOKS:

1. Meenakshi Raman, Sangeeta Sharma, *Technical Communication: Principles and Practice*, Oxford University Press, 2015
2. J.D.O Conner, *Better English Pronunciation,* Cambridge University Press 1980.
3. T.Balasubramanian, "*A Text Book of English Phonetics for Indian Students"*, Macmillan,1981
4. Penny ur *Grammar Practice Activities*, Cambridge University Press, 2010.
5. Mark Hancock, *Pronunciation in Use,* Oxford University Press 2007.
6. K. R Lakshmi Narayanan, T. Murugavan, *Managing Soft Skills,*Scitech Publications, 2010.
7. K V S G Murali Krishna, K V K K Prasad, *Placement and Personality Development,* Second Edition, Reem Publications Pvt. Limited, 2012
8. Shiv Khera, *You can Win,* Bloomsbury Publication, 2014
9. Stephen R. Covey, *The 7 Havits of Highly Effective People*, Free Press, 1989

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20CC11L5	**ENGINEERING CHEMISTRY LAB (Common To All Branches)**						

COURSE OBJECTIVES:

- To provide the students with a solid foundation in chemistry laboratory required to solve the engineering problems.
- To expose the students in practical aspects of the theoretical concepts.
- To train the students on how to handle the instruments.

COURSE OUTCOMES:

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

CO 1: Develop and perform analytical chemistry techniques to address the water related problems (hardness, alkalinity, Chlorine, DO).
CO 2: Explain the functioning of different analytical instruments.
CO 3: Compare viscosity and surface tension of different oils.
CO 4: Measure molecular/system properties such as strength of solutions, conductance of solutions and acid number of lubricating oils, etc.

LIST OF EXPERIMENTS:

Introduction to chemistry laboratory–Molarity, Normality, Primary, Secondary standard solutions, Volumetric titrations, Quantitative analysis, Qualitative analysis etc.

1. Estimation of NaOH using standard HCl solution
2. Determination of hardness of water sample by EDTA method
3. Determination of alkalinity of water sample
4. Determination of Dissolved Oxygen content of water sample by Winkler's method
5. Determination of Dissolved Chlorine by Mohr's method
6. Estimation of Fe^{+2} by using $KMnO_4$
7. Preparation of phenol formaldehyde resin/Urea formaldehyde
8. Conductometric titration between strong acid and strong base
9. Determination of viscosity of a liquid by Ostwald's viscometer
10. Determination of surface tension of a liquid by Stalagnometer
11. Determination of moisture content present in given coal sample
12. Determination of acid value of an oil

VIRTUAL LABS:

1. Soil Analysis- Determination of pH of soil
2. Water analysis - Determination of Physical parameters

TEXT BOOKS:

1. N.K Bhasin and Sudha Rani "Laboratory Manual on Engineering Chemistry" 3/e, Dhanpat Rai Publishing Company (2007).
2. Mendham J, Denney RC, Barnes JD, Thosmas M and Sivasankar B "Vogel's Quantitative Chemical Analysis" 6/e, Pearson publishers (2000).
3. Sudharani, "Lab manual on Engineering Chemistry" Dhanpat Rai Publications, Co., New Delhi. (2009).

Web References:

1. URL: https://vlab.amrita.edu

I B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME11L3	**PROBLEM SOLVING USING PYTHON PROGRAMMING LAB (OTHER THAN CSE)**						

COURSE OBJECTIVES:

- To introduce programming through Visual programming tool - Scratch
- To teach problem solving through Flow charting tool - Raptor
- To elucidate problem solving through python programming language
- To introduce function-oriented programming paradigm through python
- To train in development of solutions using modular concepts
- To teach practical Pythonic solution patterns

COURSE OUTCOMES:

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

CO 1: Create interactive visual programs using Scratch.
CO 2: Develop flowcharts using raptor to solve the given problems.
CO 3: Develop Python programs for numerical and text based problems.
CO 4: Develop graphics and event based programming using Python.

LABORATORY EXPERIMENTS:

WEEK-1:

1. Design a script in Scratch to make a sprite to draw geometrical shapes such as Circle, Triangle, Square, and Pentagon.
2. Design a script in Scratch to make a sprite to ask the user to enter two different numbers and an arithmetic operator and then calculate and display the result.

WEEK-2:

3. Construct flowcharts to
    a. calculate the maximum, minimum and average of N numbers
    b. Develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
4. Construct flowcharts with separate procedures to

. a) calculate simple and compound interest for various parameters specified by the user
b) Calculate the greatest common divisor using iteration and recursion for two numbers as specified by the user

WEEK-3:

5. Construct flowcharts with procedures to

. a)generate first N numbers in the Fibonacci series
b) Generate N Prime numbers
6. Design a flowchart to perform Linear search on list of N unsorted numbers(Iterative and recursive)

WEEK-4:

7. Design a flowchart to perform Binary search on list of N sorted numbers(Iterative and recursive)

8. Design a flowchart to determine the number of characters and lines in a text file specified by the user

WEEK-5:

9. Design a Python script to convert a Binary number to Decimal number and verify if it is a Perfect number.
10. Design a Python script to determine if a given string is a Palindrome using recursion

WEEK-6:

11. Design a Python script to sort numbers specified in a text file using lists.
12. Design a Python script to determine the difference in date for given two dates in YYYY: MM: DD format(0 <= YYYY <= 9999, 1 <= MM <= 12, 1 <= DD <= 31) following the leap year rules.
13. Design a Python Script to determine the Square Root of a given number without using inbuilt functions in Python.

WEEK-7:

14. Design a Python Script to determine the time difference between two given times in HH:MM:SS format.(0 <= HH <= 23, 0 <= MM <= 59, 0 <= SS <= 59)
15. Design a Python Script to convert a given number to words

WEEK-8:

16. Design a Python Script to convert a given number to roman number.
17. Design a Python Script to generate the frequency count of words in a text file.

WEEK-9:

18. Design a Python Script to print a spiral pattern for a 2 dimensional matrix.
19. Design a Python script to generate statistical reports (Minimum, Maximum, Count, Average, Sum etc) on public datasets.

WEEK-10:

20. Design a Python script using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorizing them into distinction, first class, second class, third class and failed.
21. Write a Python program to convert a given tuple of positive integers into an integer.

WEEK-11:

22. Write a Python program to remove the intersection of a 2nd set from the 1st set.
23. Design a Python script on oop's concepts: Class variables and instance variable
    i) Robot ii) ATM Machine

WEEK-12:

24. Write a Python program to create a dictionary grouping a sequence of key-value pairs into a dictionary of lists.
25. Write a Python program to count the number of strings where the string length is 2 or more and the first and last character are same from a given list of strings.

TEXT BOOKS:

1. Kenneth Lambert, "Fundamentals of Python: First Programs".
2. Allen B. Downey, "think python: how to think like a computer scientist",2nd edition, O'reilly,2016

REFERENCE BOOKS:

1. Python programming: A modern approach, vamsi kurama,pearson.
2. Learning python, Mark Lutz, Orielly.
3. Core python programming, W.Chun, pearson.
4. Introduction to python, Kenneth A. Lambert, Cengage.

WEB RESOURCES:

1. https://raptor.martincarlisle.com/
2. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf
3. https://zhanxw.com/blog/wp-content/uploads/2013/03/BeautifulCode_2.pdf
4. http://www.ict.ru.ac.za/Resources/cspw/thinkcspy3/thinkcspy3.pdf
5. https://www.cse.msu.edu/~stockman/ITEC/Scratch/BGC2011Scratch-Rev1.pdf
6. https://nostarch.com/scratchplayground

I B.TECH – II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Differential Equations and Vector Calculus	R20CC1201	BS	30	70	100	2	1	0	3
2	Engineering Physics	R20CC1203	BS	30	70	100	3	0	0	3
3	Engineering Drawing	R20CC1207	ES	30	70	100	1	0	4	3
4	Elements of Electrical and Electronics Engg.	R20ME1214	ES	30	70	100	3	0	0	3
5	Material Science and Metallurgy	R20ME1211	ES	30	70	100	3	0	0	3
6	Elements of Electrical and Electronics Engg. Lab	R20CC12L7	ES	15	35	50	0	0	3	1.5
7	Engineering Physics Lab	R20CC12L5	BS	15	35	50	0	0	3	1.5
8	Engineering Workshop	R20CC12L4	ES	15	35	50	0	0	3	1.5
9	Constitution of India (MC)	R20CC12MC2	MC	-	-	-	2	0	0	0
									Total	**19.5**

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20CC1201	**DIFFERENTIAL EQUATIONS AND VECTOR CALCULUS (Common to Civil, EEE, ME and ECE)**						

COURSE OBJECTIVES:

- To formulate and solve first order ordinary differential equations.
- To solve second order differential equations of various kinds.
- To find the solution of first order linear and non-linear partial differential equations.
- The skills derived from the course will help the student from a necessary base to develop analytic and design concepts.

COURSE OUTCOMES:

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

CO1: Apply first order ordinary differential equations to real life situations.
CO2: Identify and apply suitable methods in solving the higher order differential equations.
CO3: Solve the partial differentiation equations.
CO4: Interpret the physical meaning of different operators as gradient, curl and divergence.
CO5: Estimate the work done against a field, circulation and flux using vector calculus.

UNIT –I

DIFFERENTIAL EQUATIONS OF FIRST ORDER AND FIRST DEGREE: Linear-Bernoulli's-Exact equations and equations reducible to exact form.

Applications: Newton's Law of cooling, Law of natural growth and decay, Orthogonal trajectories, Electrical circuits.

UNIT-II

LINEAR DIFFERENTIAL EQUATIONS OF HIGHER ORDER: Finding the complementary functions, Inverse operator, Rules for finding the particular integrals, Method of variation of parameters. Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients.

Application: L-C-R Circuit problems.

UNIT –III

FIRST ORDER PARTIAL DIFFERENTIAL EQUATIONS: Formation of partial differential equation by elimination of arbitrary constants and arbitrary functions, solutions of first order linear (Lagrange's) equations.

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).

TEXT BOOK :

1. Dr. B.S. Grewal, "*Higher Engineering Mathematics*", 43rd Edition, Khanna Publishers, 2012.
2. B.V.Ramana, "Higher Engineering Mathematics", 32nd Edition, McGraw Hill Education, 2018.
3. Bhavanari Satyanarayana, Pradeep Kumar T.V. & Srinivasulu D, "Linear Algebra and Vector Calculus", Studera Press, New Delhi, 2017.

REFERENCES:

1. Kreyszig E, "*Advanced Engineering Mathematics*", 8th Edition, John Wiley, Singapore, 2001.
2. Greenberg M D, "*Advanced Engineering Mathematics*", 2nd Edition, Pearson Education, Singapore, Indian Print, 2003.
3. Peter V. O'Neil, *"Advanced Engineering Mathematics"*, 7th Edition, Cengage Learning, 2011.
4. N.P. Bali, Bhavanari Satyanarayana, Indrani Promod Kelkar, "*Engineering Mathematics*", University Science Press, (An Imprint of Lakshmi Publications Pvt., Ltd) New Delhi, 2012.

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC1203	**ENGINEERING PHYSICS (Common to CE and ME)**						

COURSE OBJECTIVES:

- To impart knowledge in basic concepts of wave optics, fiber optics, properties of solid crystal materials and magnetic materials, acoustics, superconductors.
- To familiarize the applications of materials relevant to engineering field.

COURSE OUTCOMES:

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

CO 1: Recognize the experimental evidence of wave nature of light and interference in thin films, Diffraction grating and Polaraisation in various fields.
CO 2: Analyze and understand various types of lasers & optical fibers.
CO 3: Identifies the crystal structures and XRD techniques.
CO 4: Knowing the applications of magnetic and superconducting materials in engineering field.
CO 5: Identifies the use of Acoustics and Ultrasonics in engineering field.

UNIT– I

Interference & Diffraction: Introduction -Interference in thin films by reflection – Newton's rings, introduction to diffraction – difference between Fresnel's and Fraunhofer diffraction - Fraunhofer diffraction at single slit (qualitative) - Diffraction grating.

Polarization: Introduction – Types of Polarization – Double refraction – Nicol's prism-Quarter wave plate and Half Wave plate - Applications

UNIT–II

Lasers: Introduction – Characteristics of lasers – Spontaneous and Stimulated emission of radiation – Population inversion – Ruby laser – Helium Neon laser-Applications.

Fiber Optics: Introduction- Basic Structure and Principle of optical fiber - Acceptance angle – Acceptance cone - Numerical Aperture-Applications.

UNIT–III

Crystallography : Introduction – Space lattice – Basis – Unit Cell – Lattice parameters – Bravais lattices – Crystal systems – Structures and packing fractions of SC,BCC and FCC.

X-Ray Diffraction: Directions and planes in crystals – Miller indices – Separation between successive (h k l) planes – Bragg's law.

UNIT-IV

Magnetic materials: Magnetic dipole moment- Magnetization- Magnetic Susceptibility- Magnetic permeability –Classification of Magnetic materials – Dia, Para, and Ferro – Hysteresis Loop- Soft and Hard magnetic materials – Applications of Magnetic materials

Superconductivity: Introduction- Properties, Meissner effect - Type-I and Type-II super conductors- BCS theory (Qualitative) – AC and DC Josephson effects - Applications of Superconductors

UNIT-V

Acoustics: Introduction – requirements of acoustically good hall– Reverberation – Reverberation time – Sabine's formula - Absorption coefficient and its determination – Factors affecting acoustics of buildings and their remedial measures.

Ultrasonics: Introduction - Properties - Production by Magnetostriction and Piezoelectric methods – Non Destructive Testing (Qualitative) – Applications.

TEXT BOOKS:

1. A.J. Dekker, "Solid state Physics", ISBN 10: 0333918339 / ISBN 13: 9780333918333, Mc Millan India Ltd, First edition, 2000.
2. M.N. Avadhanulu & P.G. Kshirasagar, "A text book of Engineering Physics", ISBN 81-219-0817-5, S. Chand publications, First Edition, 2011.
3. P. K. Palanisamy, "Engineering Physics", ISBN: 9788183714464, Scitech Publishers, 4th Edition, 2014
4. M.R. Srinivasan, "Engineering Physics", ISBN978-81-224-3636-5, New Age international publishers, 2nd Edition,2014

REFERENCE BOOKS:

1. Charles Kittle, "Introduction to solid state physics" ISBN: 9788126578436, Willey India Pvt.Ltd, 5TH edition, 2012.
2. M.Arumugam, "Applied Physics", ISBN: 81-89638-01-7, Anuradha Agencies, 4th edition, 2013.
3. D.K.Bhattacharya, "Engineering Physics", ISBN: 0198065426, 9780198065425, Oxford University press, 2nd edition, 2010.
4. Sanjay D Jain and Girish G Sahasrabudhe "Engineering Physics", University Press ISBN: 8173716781,1st edition, 2010.
5. B.K.Pandey & S. Chaturvedi "Engineering Physics" ISBN: 8131517616, Cengage Learning, 1st edition, 2012.

Web References:

1. http://link.springer.com/physics
2. http://www.thphys.physics.ox.ac.uk
3. http://www.sciencedirect.com/science
4. http://www.e-booksdirectory.com

E-Books:

1. http://www.peaceone.net/basic/Feynman
2. http://physicsdatabase.com/free-physics-books
3. http://www.damtp.cam.ac.uk/user/tong/statphys/sp.pdf
4. http://www.freebookcentre.net/Physics/Solid-State-Physics-Books.html

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	1	0	4	30	70	100	3
Code: R20CC1207	**ENGINEERING DRAWING**						

COURCE OBJECTIVES:

- The students to use drawing instruments and to draw polygons, engineering Curves & engineering scales.
- The students use to make orthographic projections, projections of points, simple lines & projections of the lines inclined to both the lines.
- The students use to draw the projections of the planes inclined to both the plane.
- The students use to draw the projections of solids & development of surfaces.
- The students use to draw conversion of isometric views to orthographic views vice versa and to learn basic drawing commands in auto cad.

COURSE OUTCOMES:

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

CO1: Construct the geometrical shapes of regular polygons, Engineering Curves, and scales.

CO2: Illustrate the orthographic projections, projections of points, and lines inclined to both the planes.

CO3: Construct the projection of planes inclined to both the planes.

CO4: Analyze the projection of solids and the development of surfaces for regular solids.

CO5: Analyze the conversion of isometric views to orthographic views vice versa.

UNIT– I

THE BASIC CONCEPTS IN ENGINEERING DRAWING: Introduction to engineering drawing instruments, lettering and dimensioning practice. Geometrical constructions- Constructing regular polygons by general methods.

CURVES USED IN ENGINEERING PRACTICE: Introduction to conic sections, construction of ellipse parabola, hyperbola by eccentricity method. Construction of ellipse by - Arcs of circles Method, Concentric Circles Method and Oblong Method, & parallelogram methods.

ENGINEERING SCALES: Introduction scales on drawings Representation fraction: Construction of plain, diagonal and vernier scale.

UNIT–II

ORTHOGRAPHIC PROJECTIONS: Introduction to type of projections, first angle and third angle projections.

PROJECTION OF POINTS: Principles of orthographic projection – Convention.

PROJECTIONS OF STRAIGHT LINES:

Projections of straight lines parallel to both the planes, parallel to one plane and inclined to the other plane. Lines inclined to both the planes, determination of true lengths, angle of inclination and traces.

UNIT–III

PROJECTIONS OF PLANES: regular planes perpendicular / parallel to one plane and inclined to the other reference plane; inclined to both the reference planes.

UNIT-IV

PROJECTIONS OF SOLIDS: introduction to projections of solids, types of solids: prisms, pyramids, cones and cylinders –simple positions and the axis inclined to one of the planes.

DEVELOPMENT OF SURFACES: Development of surfaces of right regular solids- Prisms, Cylinder, Pyramids, Cone and their sectional parts

.

UNIT-V

INTRODUCTION OF ISOMETRIC VIEWS: Isometric projections & orthographic projections. Conversion of isometric views to orthographic views and orthographic views to isometric views.

INTRODUCTION TO AUTO CAD: Practice on Draw, Edit & Modify commands using auto CAD.

TEXT BOOKS:

1. Engineering Drawing by N.D. Butt, Chariot Publications.
2. Engineering Drawing by K.L.Narayana & P. Kannaiah, Scitech Publishers.

REFERENCE BOOKS:

1. Engineering Graphics for Degree by K.C. John, PHI Publishers.
2. Engineering Drawing by Basant Agarwal & CM. Agarwal, Tata McGraw Hill Publishers.

Web References:

1. https://www.youtube.com/watch?v=ohhdNRtDpCY,

E-Books:

1. https://www3.nd.edu/~cpoellab/teaching/cse40814/Lecture1-Handouts.pdf

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME1214	**ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGG.**						

COURSE OBJECTIVES:

- To familiarize with the basic DC network.
- To explain the concepts of electrical machines and their characteristics.
- To identify the importance of transformers and induction motor.
- To impart knowledge about the characteristics of semiconductor devices.
- To expose basic concepts and applications of Transistor

COURSE OUTCOMES:

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

CO 1: Analyze the behaviour of an electrical circuit.

CO 2: Measure the performance quantities such as losses, efficiency of DC machines

CO 3: Create the construct of transformer and Induction motor

CO 4: Classify the importance and applications of p-n junction diode.

CO 5: Evaluate the configurations and applications of Transistor.

UNIT-I

Basic laws and Circuits: Active and passive elements-voltage-current-power-power factor-energy-Ohms law-Kirchhoff's Laws-series and parallel circuits-source transformations-delta-wye conversion.

UNIT-II

DC Machines: Principle Operation-Constructional features-induced EMF-Types of DC generators-Working of DC motor-Torque expression-3point starter-Speed controls-Losses and Efficiency by direct loading.

UNIT-III

Transformers: Constructional details-working principle-EMF equation-voltage regulation-losses and efficiency-open/short circuit tests.

Induction Motors: 3-Phase Induction motor Construction-working principle-Types-slip-Performance characteristics-1-phase Induction motor working principle-applications

UNIT –IV

Semiconductor Devices: Introduction-Bonds-extrinsic-intrinsic-p-n Junction diode-current and voltage characteristics-rectifier circuits-half wave-full wave-bridge rectifier-Zener diode as Voltage Regulator- Characteristics of operation amplifiers (OP-AMP) – application of OP-AMPs (inverting, non-inverting, integrator and differentiator)

UNIT –V

Transistor Configurations: Construction-working-Transistor as amplifier-Transistor as switch - Analysis of CE, CB and CC Characteristic's-Comparison of CE, CB and CC configurations.

TEXT BOOKS:

1. D.P.Kothari, I.J.Nagrath, Basic Electrical and Electronics Engineering, 1stedition, McGraw Hill Education (India) Private Limited, 2017.
2. B.L. Theraja, Fundamentals of Electrical Engineering and Electronics, 1stedition, S. Chand Publishing, New Delhi, 2006.
3. Adel S. Sedra and Kenneth C. Smith, Microelectronic Circuits 6th edition, Oxford University Press, 2014.
4. V.K. Mehta, "Principle of Electrical and Electronics Engg." S.Chand publishing, New Delhi, 2006.

REFERENCES:

1. S.K.Bhattacharya, Basic Electrical and Electronics Engineering, Pearson Education, 2011.
2. Dharma Raj Cheruku, B T Krishna, Electronic Devices and Circuits, 2/e, Pearson Education, 2008.
3. R.K.Rajput, Basic Electrical and Electronics Engineering, University Science Press, New Delhi, 2012.

Web References:

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

E-Books:

1. https://www3.nd.edu/~cpoellab/teaching/eee40814/Lecture1-Handouts.pdf

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME1211	**MATERIAL SCIENCE AND METALLURGY**						

COURSE OBJECTIVES:

- To learn the principles of materials science and engineering though lab investigation
- To learn to organize the lab results into a logic, concise and accurate report
- To review physics and chemistry in the context of materials science and engineering
- To give an introduction to metals, ceramics, composites powder metallurgy

COURSE OUTCOMES:

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

CO 1: Illustrate the knowledge related to the structure and properties of materials, crystal Systems and phase diagrams of alloys.

CO 2: Examine properties of ferrous materials and their engineering applications

CO 3: Explain the basic concepts of Heat treatment processes and their applications

CO 4: Examine nonferrous materials properties and their engineering applications.

CO 5: Choose the various types of ceramics, composite materials and basic steps involved in the Powder Metallurgy process.

UNIT– I

STRUCTURE OF METALS AND CONSTITUTION OF ALLOYS: Ionic, Covalent and Metallic bonds; Amorphous and Crystalline solids. Crystal structure - BCC, FCC, HCP. Crystallization of metals, Necessity of alloying, substitutional and interstitial solid solutions.

EQUILIBRIUM DIAGRAMS: Introduction, Importance and types - Unary, Binary and Ternary phase diagrams; Binary phase diagrams of Fe-Fe_3C and Cu-Ni. Micro constituents in steels- Austenite, Ferrite, Cementite, Pearlite, Bainite, Martenite; eutectic, peritectic, eutectoid and peritectoid reactions. Cooling curve of pure iron, Lever Rule, Gibbs Phase Rule.

UNIT –II

FERROUS METALS AND ALLOYS:

STEELS: Introduction, Extraction of steel, basic furnaces to make Iron and Steel. Classification and Influence of constituents on steel; Structure, properties and applications of plain carbon steels; Alloy steels-Purpose and effect of alloying elements; Properties of Stainless steels.

CAST IRON: Introduction, comparison with steels and Classification-Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, S.G. cast iron.

UNIT – III

HEAT TREATMENT OF ALLOYS: Purpose of heat treatment; Process and applications of Annealing, Normalizing, Hardening and tempering; TTT diagrams, Hardenability and factors affect hardening; Surface Hardening of Steels- Carburizing, Nitriding, Cyaniding.

UNIT – IV

NON-FERROUS METALS AND ALLOYS: Introduction, Structure and properties of copper, Aluminium, Titanium and their alloys.

UNIT – V

CERAMICS: Introduction; Glasses, Abrasive materials.

COMPOSITE MATERIALS: Introduction, types - particle reinforced, fiber reinforced and structural composites.

POWDER METALLURGY: Introduction, preparation, industrial applications, advantages and limitations.

TEXT BOOKS:

1. Introduction to Physical Metallurgy by Sidney H. Avener, TataMcGraw Hill
2. Material Science and Metallurgy by V.D.Kodgire, Everest Publishing House

REFERENCES:

1. Materials Science and engineering by Callister and Baalasubrahmanyam, Wiley India
2. Material science and Engineering by V. Rahghavan, P.H.I Publications
3. Material Science and Metallurgy by A V K Suryanarayana, B S Publications
4. Material Science and Metallurgy by U. C. Jindal by Pearson Publications

WEB REFERENCES:

1. http://nptel.ac.in/courses/Webcourse
2. contents/IIScBANG/Material%20Science/pdf/Lecture Notes/ MLN_02.pdf
3. http://nptel.ac.in/courses/113105023/Lecture7.pdf
4. http://nptel.ac.in/courses/Webcourse-contents/IIScBANG/Material%20Science/pdf/PPTs/ MTS_07_m.pdf
5. http://nptel.ac.in/courses/IITMADRAS/Design_Steel_Structures_I/1_introduction/3_properties _of_steel.pdf
6. http://nptel.ac.in/courses/112108150/pdf/Lecture_Notes/MLN_10.pdf

E-Books:

1. https://www.ebooks.com/en-us/subjects/technology-metallurgy-ebooks/1211/
2. http://www.digitalbookindex.org/_search/search010mmetallurgya.asp
3. https://www.pdfdrive.com/metallurgy-books.html
4. https://www.elsevier.com/books/fundamentals-of-metallurgy/seetharaman/978-1-85573-927-7
5. https://ebooks.benthamscience.com/book/9781681085708/

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20CC12L7	**ELEMENTS OF ELECTRICAL AND ELECTRONICS ENGG. LAB (Common to ME and CE)**						

COURSE OBJECTIVES:

- To expose the students to the operation of DC motor, Transformer and rectifiers give them experimental skill.

COURSE OUTCOMES:

After completion of the course, the students will able to

CO1: Determine the efficiency and regulation of 1-phase transformer

CO2: Compute the performance characteristics of transformers and DC machines through suitable tests.

CO3: Calculate the ripple factor of half-wave & full-wave rectifiers.

CO4: Gain practical experience related to electronics circuits; stimulate more interest and Motivation for further studies of electrical circuits.

LIST OF EXPERIMENTS

Any 5 of the following experiments to be conducted from each PART:

PART-A: Electrical Experiments:

1. Verification of Kirchhoff's law.
2. Swinburne's test and Predetermination of efficiencies as Generator and Motor
3. Brake test on DC shunt motor. Determination of performance curves
4. Speed control of D.C shunt motor by a) Armature voltage control b) Field flux control method.
5. OC & SC tests on single phase transformer (predetermination of efficiency and regulation).
6. Load test on three-phase induction motor.

PART-B: Electronics Experiments:

1. PN junction diode characteristics a) Forward bias b) Reverse bias
2. Transistor CE characteristics (input and output).
3. Half wave rectifier characteristics with and without filter
4. Full wave rectifier characteristics with and without filter
5. Characteristics of CE Amplifier.
6. Characteristics of CC Amplifier.

Virtual lab:

1. Verification of Kirchhoff's law.
2. Brake test on DC shunt motor. Determination of performance curves
3. Full wave rectifier characteristics with and without filter

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20CC12L5	**ENGINEERING PHYSICS LAB (Common to CE and ME)**						

COURSE OBJECTIVES:

- To impart physical measurement skills and make the students understand coherence between theoretical and practical knowledge.

COURSE OUTCOMES:

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

CO1: Understand the principle of physics and interpret them in engineering field and compares the results with theoretical calculations.

CO2: Ability to use modern engineering physics techniques and tools in real time applications in engineering studies.

CO3: The student will be enabled to know about the characteristics and the behaviour of materials in a practical manner and gain knowledge and its usage.

LIST OF EXPERIMENTS:

1. Rigidity modulus of material by wire-dynamic method (torsional pendulum)
2. Determination of wavelength of a source-Diffraction Grating-Normal incidence
3. Newton's rings –Radius of Curvature of Plano Convex Lens.
4. Determination of thickness of thin wire- Air wedge method
5. Determination of wavelength of Laser Source-single slit diffraction.
6. Determine the Numerical aperture of an optical fiber.
7. Melde's experiment – Transverse and Longitudinal modes.
8. Magnetic field along the axis of a current carrying coil – Stewart and Gee's apparatus.
9. Verification of laws of stretched string by using Sonometer.
10. Calculate the energy loss in a given ferromagnetic material by plotting B-H Curve.
11. Energy Band gap of a Semiconductor p - n junction.
12. Characteristics of Thermistor – temperature coefficient

TEXT BOOKS:

1. Engineering Physics Lab Manual by Dr.Y. Aparna & Dr.K.Venkateswarao (V.G.S.Book links).
2. Physics Practical Manual, Lorven Publications
3. S. Balasubramanian , M.N. Srinivasan " A Text book of Practical Physics"- S Chand Publishers, 2017.

Web References:

1. https://www.youtube.com/watch?v=NDsSPtL9dyQ

2. https://www.youtube.com/watch?v=9agoJRCnu4w
3. https://www.youtube.com/watch?v=bv-lLJreyCU
4. http://vlab.amrita.edu/index.php

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20CC12L4	**ENGINEERING WORKSHOP**						

COURSE OBJECTIVES:

- To impart knowledge to students to develop their technical skill sets for creating entities from raw material.
- To give hands on training and practice to students for use of various tools, devices, machines.
- To develop ability of students to understand, plan and implement various processes and operations to be performed on the raw material to create object of desired shape and size.

COURSE OUTCOMES:

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

CO 1: Make Use of the various carpentry tools, machines, devices used in engineering practice for preparing different carpentry joints.

CO 2: Make Use of the various fitting tools, machines, devices used in engineering practice for preparing different Fits.

CO 3: Develop different components using Tin Smithy and black smithy tools.

CO 4: Demonstrate the various house wiring connections for different house wiring connections.

CO 5: Demonstrate the need of PC hardware components, applications and software.

LIST OF EXPERIMENTS:

ENGINEERING WORKSHOP TRADES FOR EXERCISE:

CARPENTRY

1. Cross-Lap joint
2. Dove tail joint

FITTING

1. V-fit
2. Square fit

TINSMITHY

1. Square box without lid
2. Tapper tray

HOUSE WIRING

1. Two lamps series connection & parallel connection
2. Fluorescent Tube Wiring & Stair Case Wiring

BLACK SMITHY

1. S-Hook
2. Round rod to square rod

IT WORKSHOP: (Minimum 7 tasks need to be completed)

PC Hardware:

Identification of basic peripherals, assembling a PC, installation of system software like MS Windows, device drivers. Trouble shooting Hardware and Software some tips and tricks.

Internet & World Wide Web:

Different ways of hooking the PC on to the internet from home and workplace and effectively usage of the internet, web browsers, email, newsgroups and discussion forums. Awareness of cyber hygiene (protecting the personal computer from getting infected with the viruses), worms and other cyber-attacks.

Productivity tools: Crafting professional word documents; excel spread sheets, power point presentations and personal websites using the Microsoft suite of office tools.

PC Hardware

Task 1: Identification of the peripherals of a computer. To prepare a report containing the block diagram of the CPU along with the configuration of each peripheral and its functions. Description of various I/O Devices.

Task 2: (Optional): A Practice on disassembling the components of a PC and assembling them to back to working condition.

Task 3: Examples of Operating Systems- DOS, MS Windows, Installation of MS windows on a PC

Task 4: Introduction to Memory and Storage Devices, I/O Port, Device Drivers, Assemblers, Compilers, Interpreters, Linkers, Loaders.

Task 5: Hardware Troubleshooting (Demonstration): Identification of a problem and fixing a defective PC (improper assembly or defective peripherals).

Software Troubleshooting (Demonstration): Identification of problem and fixing the PC for any software issues.

Internet & Networking Infrastructure

Task 6: Demonstrating Importance of Networking, Transmission Media, Networking Devices-Gateway, Routers, Hub, Bridge, NIC, Bluetooth technology, Wireless Technology, Modem, DSL, and Dialup Connection.

Orientation & Connectivity Boot Camp and Web Browsing: Students are trained to configure the network settings to connect to the Internet. They are trained to demonstrate the same through web browsing (including all tool bar options) and email access.

Task 7: Search Engines & Netiquette:

Students are enabled to use search engines for simple search, academic search and any other context based search (Bing, Google etc).Students are acquainted to the principles of micro-blogging, wiki, collaboration using social networks, participating in online technology forums.

Task 8: Cyber Hygiene (Demonstration) : Awareness of various threats on the internet. Importance of Security patch updates and Anti-Virus solution Ethical Hacking, Firewalls, Multi-factors authentication techniques including Smart card Biometrics and also practiced

WORD

Task 9: MS Word Orientation: Accessing, overview of toolbars, saving files, Using help and resources, rulers, formatting, Drop Cap, Applying Text effects, Using Character Spacing, OLE in Word, using templates, Borders and Colors, Inserting Header and Footer, Using Date and Time option, security features in word, converting documents while saving.

Task 10 : Creating Project : Abstract Features to be covered:-Formatting Styles, Inserting Table, Bullets and Numbering, Changing Text Direction, Cell alignment, footnote, Hyperlink, Symbols, Spell Check, Track Changes, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes and Paragraphs.

EXCEL

Task 11: Using spread sheet features of EXCEL including the macros, formulae, pivot tables, graphical representations.

Creating Scheduler - Features to be covered:-Gridlines, Format Cells, Summation, auto fill, Formatting Text.

LOOKUP/VLOOKUP

Task 12: Performance Analysis: Features to be covered:-Split cells, freeze panes, group and outline, Sorting, Boolean and Logical operators, Conditional Formatting.

POWER POINT

Task 13: Students will be working on basic power point utilities and tools which help them create basic power point presentation. Topic covered during this week includes:- PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows, Hyperlinks, Inserting –Images, Clip Art, Tables and Charts in PowerPoint.

Task 14: Focusing on the power and potential of Microsoft power point Helps them learn best practices in designing and preparing power point presentation. Topic covered during this week includes:- Master Layouts (slide, template and notes), Types of views (basic, presentation, slide slotter, notes etc), Inserting – Background , textures, Design Templates, Hidden slides, OLE in PPT

I B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	0	0	-	-	-	0
Code: R20CC12MC2	**CONSTITUTION OF INDIA (MC)**						

COURSE OUTCOMES:

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

CO 1: Examine salient features of Indian Constitution and live accordingly in society & interpret the meaning of Fundamental Rights of State Policy

CO 2: Discover various aspects of Union Government legislation and live up to the expectations of the rules.

CO 3: Examine State Government legislation and improve your living standards by following the rules strictly

CO 4: Examine powers and functions of local bodies such as Municipalities and Panchayats and, take advantage of available resources for better living

CO 5: Analyze the powers and functions of Election Commission and The Union Public Service Commission and decide upon it for safe and secured life.

UNIT-I

INTRODUCTION TO INDIAN CONSTITUTION & FUNDAMENTAL RIGHTS: Meaning of the term Indian Constitution –Preamble- Constituent Assembly- Salient Features of Indian Constitution. Fundamental Rights -Fundamental Duties -The Directive Principles of State Policy.

UNIT-II

UNION GOVERNMENT: Union Government -Union Legislature (Parliament) -Lok Sabha and Rajya Sabha (with Powers and Functions) -Union Executive -President of India (with Powers and Functions) -Prime Minister of India (with Powers and Functions) -Union Judiciary (Supreme Court) -Jurisdiction of the Supreme Court

UNIT-III

STATE GOVERNMENT: State Government -State Legislature (Legislative Assembly / Vidhan Sabha, Legislative Council / Vidhan Parishad) -Powers and Functions of the State Legislature -State Executive-Governor of the State (with Powers and Functions) -The Chief Minister of the State (with Powers and Functions) -State Judiciary (High Courts)

UNIT-IV

LOCAL SELF GOVERNANCE: Powers and functions of Municipalities, Panchyats, ZP's and Co – Operative Societies

UNIT-V

SOVEREIGN BODIES: Election Commission of India (with Powers and Functions) -The Union Public Service Commission (with Powers and Functions)

TEXT BOOKS:

1. Introduction to constitution of India, Durga Das Basu, Lexis Nexis Publication.
2. Constitution of India by PRFESSIONAL BOOK PUBLISHERS.
3. The Constitution of India by Arun K Tiru vengadam, Blooms bury publishers.

4. The constitution of India by PM Bakshi, Universal law publishing co
5. The Constitution of India by S.R. Bhansali, Universal law publishing co

II B.TECH – I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Numerical Methods and Transformations	R20CC2101	BS	30	70	100	2	1	0	3
2	Fluid Mechanics and Hydraulic Machinery	R20ME2102	PC	30	70	100	2	1	0	3
3	Metrology and Instrumentation	R20ME2103	PC	30	70	100	3	0	0	3
4	Thermodynamics	R20ME2104	PC	30	70	100	2	1	0	3
5	Mechanics of Solids	R20ME2105	PC	30	70	100	2	1	0	3
6	FMHM Lab	R20ME21L1	PC	15	35	50	0	0	3	1.5
7	MOS and Metallurgy Lab	R20ME21L2	PC	15	35	50	0	0	3	1.5
8	Metrology and Instrumentation Lab	R20ME21L3	PC	15	35	50	0	0	3	1.5
9	Solid Modelling	R20ME21SC1	SC	-	50	50	0	0	4	2
10	Environmental Studies	R20CC21MC1	MC	-	-	-	2	0	0	0
									Total	**21.5**

II B.Tech I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20CC2101	**NUMERICAL METHODS AND TRANSFORMATIONS (For CIVIL, EEE, ME and ECE)**						

COURSE OBJECTIVES:

- To elucidate the different numerical methods to solve nonlinear algebraic equations.
- To propagate the use of different numerical techniques for carrying out numerical integration.
- Explore the use of Laplace transform method to solve with initial value problems of ODE.
- To acquire fundamental Knowledge of Fourier series and Fourier Transform and able to give Fourier expansions of a given function.

COURSE OUTCOMES:

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

CO1: Evaluate approximating roots of polynomials and transcendental equations by different algorithms.

CO2: Apply Newton's forward backward and Lagrange's interpolation for equal and unequal intervals.

CO3: Apply different algorithms for approximating solutions of ordinary differential equation to its analytical computations.

CO4: Select appropriate technique of Laplace transforms in solving differential equations.

CO5: Relate Fourier series, integral, transforms techniques in their core.

UNIT –I

SOLUTIONS TO ALGEBRAIC EQUATIONS AND INTERPOLATION: Solution of polynomial and transcendental equations: bisection method, Regula-Falsi method and Newton-Raphson method. Finite differences, relation between operators, interpolation using Newton's, Gauss's forward and backward difference formulae. Interpolation with unequal intervals: Lagrange's formulae.

UNIT –II

NUMERICAL SOLUTIONS OF ODE AND INTEGRATION: Numerical Differentiation, Ordinary differential equations-Taylor's series, Euler and modified Euler's methods. Runge-Kutta method of fourth order for solving first and second order equations. Numerical integration- trapezoidal rule and Simpson's 1/3rd and $3/8^{th}$ rules.

UNIT-III:

LAPLACE TRANSFORMATIONS: Laplace transform and its properties, Transform of derivatives and integrals, Multiplication by t^n, division by t, Unit step function and unit impulse function. Transform of periodic functions, Evolutions of integrals by Laplace Transforms. Finding inverse transforms by the method of partial fractions, other methods of finding inverse Laplace Transforms, Convolution theorem (without proof), Solutions of Initial and Boundary Value Problems.

UNIT – IV:

FOURIER SERIES: Introduction, Euler's formulae, Periodic functions, Dirichlet's conditions, conditions for a Fourier expansion, functions of any period, functions having points of discontinuity, odd and even functions - half range series.

UNIT – V:

FOURIER TRANSFORMS: Fourier integral theorem (without proof), Fourier cosine and sine integrals, Fourier transform, Fourier sine and cosine transforms, properties of Fourier Transforms, convolution theorem (without proof).

TEXT BOOK:

1. B.S.Grewal, Higher Engineering Mathematics, 43rd Edition, Khanna Publisher.
2. B.V.Ramana, "Higher Engineering Mathematics", 32nd Edition, McGraw Hill Education, 2018.

REFERENCES:

1. N.P. Bali, Bhavanari Satyanarayana, Indrani Promod Kelkar, "Engineering Mathematics", University Science Press, (An Imprint of Lakshmi Publications Pvt., Ltd) New Delhi, 2012.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 9thEditiwiley-India.
3. Peter V. O'Neil, "Advanced Engineering Mathematics", 7th Edition, Cengage Learning, 2011.

II B.Tech I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20ME2102	**FLUID MECHANICS AND HYDRAULIC MACHINERY**						

COURSE OBJECTIVES:

- To understand the concept of fluid statics and properties of fluids.
- To understand the fluid kinematics and dynamics.
- Get the knowledge of boundary layer theory to solve the problems.
- To understand velocity diagrams on different vanes.
- Learn the working of different kinds of turbines and pumps.

COURSE OUTCOMES:

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

CO 1: Explain about Fluid Properties and hydrostatic forces acting on different surfaces

CO 2: Apply conversation laws to fluid flow problems in engineering applications

CO 3: Compute theory of Boundary layer flows, Identifies dimensionless parameters

CO 4: Illustrate the force required to move the vane using by Jet

CO 5: Demonstrate the turbines and its functions & Operating conditions of Centrifugal and Reciprocating pumps.

UNIT - I

PROPERTIES OF FLUIDS AND FLUID STATICS: Fluid properties: Mass density, specific weight, specific volume, specific gravity, viscosity, vapour pressure, compressibility, surface tension and capillarity.

FLUID STATICS: Fluid pressure at a point, variation of pressure within a static fluid, hydrostatic law - Pressure head, Pascal's law, Measurement of pressure, U-Tube manometer, Differential U-Tube manometer.

UNIT - II:

FLUID KINEMATICS: Lagrangian and Eulerian approach of fluid flow: velocity and acceleration of fluid particles, different types of fluid flow, description of flow pattern: Stream line, streak line, path line. Principle of conservation of mass: Continuity equation, applications of continuity equation.

FLUID DYNAMICS: Euler's equation of motion along a stream line - Bernoulli's equation, Practical applications of Bernoulli's equation in flow measurement devices like venturimeter, orifice meter and Pitot tube.

UNIT – III:

BOUNDARY LAYER THEORY: Boundary layer development on a flat plate and its characteristics - Boundary layer thickness, displacement thickness, momentum thickness, energy thickness.

DIMENSIONAL AND MODEL ANALYSIS: Dimensional analysis: dimensions, dimensional homogeneity, methods of dimensional analysis-Buckingham Pi theorem, Raleigh's method, Model analysis. Similitude, derivations of important dimensionless numbers.

UNIT – IV:

BASICS OF TURBO MACHINERY: Hydrodynamic force or jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, work done and efficiency, flow over radial vanes

HYDRAULIC TURBINES: Classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies.

UNIT - V:

HYDRAULIC PUMPS: Classification, working, work done - manometric head losses and efficiencies, specific speed- pumps in series and parallel-performance characteristic curves, NPSH; Reciprocating pump, centrifugal pump.

TEXT BOOKS:

1. Fluid Mechanics and Hydraulics Machines by R.K.Bansal, Laxmi publications
2. Fluid Mechanics and Hydraulic Machines by R.K.Rajput, S. Chand Publications

REFERENCE BOOKS:

1. Fluid Mechanics by White.F.M, Tata McGraw-Hill, 5th Edition, New Delhi, 2003.
2. Hydraulics and Fluid Mechanics by P.N.Modi and S.M.Sethi, Standard Book House, New Delhi.

WEB REFERENCES:

1. https://nptel.ac.in/courses/105101082/ Fluid Mechanics by Prof S K Som, Department of Mechanical Engineering

II B.Tech I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME2103	**METROLOGY AND INSTRUMENTATION**						

COURSE OBJECTIVES:

- Inspection of engineering parts with various precision instruments.
- Design of part, tolerances and fits.
- Principles of measuring instruments and gauges and their uses.
- Imparting the principles of measurement which includes the working mechanism of various displacement transducers, measurement of temperature and pressure gauges.

COURSE OUTCOMES:

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

CO 1: Explain the design tolerances and fits for selected product quality.
CO 2: Illustrate the standards of length, angle measurement.
CO 3: Demonstrat**e** the concepts of limit gauges and optical measurements.
CO 4: Explain of various transducers to measure displacement
CO 5: Analyze various temperature and pressure transducers for engineering applications

UNIT– I

SYSTEMS OF LIMITS AND FITS: Introduction, nominal size, tolerance, limits, deviations, fits - Unilateral and bilateral tolerance system, form tolerance, Assembly tolerance and tolerance estimation methods, hole and shaft basis systems- interchangeability and selective assembly. International standard system of tolerances, selection of limits and tolerances for correct functioning.

UNIT–II

LINEAR MEASUREMENT: Length standards, end standards, slip gauges- calibration of the slip gauges, dial indicators, micrometres.

MEASUREMENT OF ANGLES AND TAPERS: Different methods – bevel protractor, angle slip gauges- spirit levels- sine bar, rollers and spheres used to measure angles and tapers.

UNIT–III

LIMIT GAUGES: Taylor's principles-design of GO and NO GO gauges; plug, ring, snap, gap, taper, profile and position gauges**.**

OPTICAL MEASURING INSTRUMENTS: Tools maker's microscope and uses, autocollimators, optical projector, optical flats and their uses. Need of inspection, surface testing, surface finish, Laser instrumentation.

UNIT-IV

BASIC PRINCIPLES OF INSTRUMENTATION: Selection of instrumentation**,** Units and standards – Static measurements – Scale and pointer type instruments – Definition of range, sensitivity, hysteresis, accuracy, precision, reliability, repeatability, linearity, drift, Static and dynamic response, reproducibility, calibration procedure, errors in measuring instruments, source of errors.

MEASUREMENT OF DISPLACEMENT: Theory and construction of various transducers to measure displacement - LVDT, piezo electric, inductive, capacitance, resistance.

UNIT-V

MEASUREMENT OF TEMPERATURE: Classification, ranges, various principles of measurement, expansion, electrical resistance, thermistor, thermocouple.

MEASUREMENT OF PRESSURE: Units - classification – different principles used. Manometers, piston, bourdon pressure gauges, bellows - diaphragm gauges. Low pressure measurement, McLeod pressure gauge.

TEXT BOOKS:

1. Engineering Metrology, Mahajan, Dhanpat Rai Publishers.
2. Measurement Systems Applications & design by D.S Kumar, Khanna Publishers.

REFERENCE BOOKS:

1. Engineering Metrology, R.K.Jain, Khanna Publishers.
2. Engineering Metrology by I.C.Gupta, DhanpatRai Publishers.
3. Mechanical and Industrial Measurements, R.K. Jain, Khanna Publishers.

WEB REFERENCES:

1. https://www.youtube.com/watch?v=HpIEeBtJupY&list=PLbMVogVj5nJSZiwuh_tp50dKry8mCxzKA&index=1

E-BOOKS:

1. http://www.gvpce.ac.in/syllabi/Engineering%20Metrology.pdf

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20ME2104	**THERMODYNAMICS**						

COURSE OBJECTIVES:

- To acquire the knowledge of first law of thermodynamics and its analysis.
- To learn the second law of thermodynamics and significance of entropy principles.
- To learn the concepts of reactant, non-reactant gas mixtures and pure substance.
- To understand the significance of various thermal cycles.

COURSE OUTCOMES:

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

CO 1: Illustrate the concepts of heat, work, and forms of energy

CO 2: Classify various thermal systems using thermodynamic laws and principles.

CO 3: Apply the laws of thermodynamics for various thermodynamic systems.

CO 4: Evaluate the performance parameters of pure substances and gas mixtures.

CO 5: Analyze different thermodynamic cycles and estimate work done and performance

UNIT - I

BASIC CONCEPTS AND DEFINITIONS: Thermodynamic fundamentals, Thermodynamic equilibrium and Quasi-static Process, thermodynamic path, cycle, Work and Heat, work done in various non-flow processes.

ZEROTH LAW OF THERMODYNAMICS: Temperature Scales, Temperature measurement, Constant Volume Gas Thermometer, Advantages of gas thermometers over liquid thermometers

UNIT-II

FIRST LAW: First law of thermodynamics for a system undergoing a cycle and for a change in state. First Law Analysis of Closed System, Thermodynamic processes, Different forms of stored energy, Energy-Forms of Energy, PMM-I.

FIRST LAW FOR FLOW SYSTEMS: Steady flow energy equation and applications, limitations of first law of thermodynamics

UNIT - II

SECOND LAW OF THERMODYNAMICS: Introduction, Thermal Energy Reservoirs, Heat Engines, Refrigerators, Heat Pumps, Kelvin-Planck and Clausius Statements of Second law of Thermodynamics, Equivalence of Kelvin-Plank and Clausius Statements, PMM II, Differences between reversible and Irreversible Process, Carnot Cycle, Carnot Theorem.

ENTROPY: Introduction, temperature-entropy Plot, Principle of increase of entropy, Entropy Change for Ideal gases, Applications of Entropy.

UNIT - III:

PURE SUBSTANCES: Pure substance, vapour-liquid-solid phase equilibrium in a pure substance, Independent properties of a pure substance, Equations of state for vapour phase of a simple compressible substance, Tables of thermodynamic properties, thermodynamic surfaces.

MIXTURES OF PERFECT GASES– Mole Fraction, Mass fraction Gravimetric and volumetric Analysis – Dalton's Law of partial pressure, Avogadro's Law of additives.

UNIT - V:

POWER CYCLES: Carnot, Otto, Diesel, Dual cycles– Description and representation on P-V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles, Brayton and Rankine cycles.

REFRIGERATION CYCLES: Reversed Carnot cycle, VCR system basics, air refrigeration, Bell-Coleman Cycle

TEXT BOOKS:

1. Thermodynamics Engineering Approach by Yunus A. Cengel M. and Michael A. Boles, Seventh edition, McGraw Hill Education (India) Private Limited, 2011.
2. Engineering Thermodynamics by P.K.Nag, Fifth edition, Tata McGraw Hill Education Private Limited, 2012.

REFERENCES:

1. Fundamentals of Classical Thermodynamics by G.J.Van Wylen and Sonntag, 4th Edition, 1994 Wiley publication 2005.
3. Thermal Engineering by R.K. Rajput, 8th Edition, Lakshmi Publications
4. Engineering Thermodynamics by P.Chattopadhyay, Oxford Higher Edn Publications
5. Thermodynamics by J.P.Holman, McGrawHill.

Web References:

1. https://nptel.ac.in/courses/112/105/112105123/
2. https://ocw.mit.edu/courses/chemistry/5-60-thermodynamics-kinetics-spring-2008/lecture-notes/
3. https://www2.ph.ed.ac.uk/~gja/thermo/

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20ME2105	**MECHANICS OF SOLIDS**						

COURSE OBJECTIVES:

- To understand stresses and deformation in a member due to an axial loading. Also to estimate the thermal stresses, strains and strain energy in members subjected to axial loading.
- Understand the concept of shear force and bending moment with respect to beams and to draw the shear force and bending moment diagrams.
- Understand bending and shear stresses in beams of various cross sections under different loading conditions.
- Understand and analyze beam deflections using various methods like double integration approach, Macaulay's method.
- Study the pressure vessels, their classification and to estimate various stresses such as radial, circumferential, longitudinal and shrinkage induced in them, concepts of torsion.

COURSE OUTCOMES:

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

CO 1: Illustrate the concepts of stress and strain and thermal stress in members, strain energy due gradually, suddenly applied loads.

CO 2: Analyze shear force diagrams and bending moment diagrams to the different loads for the different support arrangements.

CO 3: Determine shear stresses induced in the beams which are made with different cross sections like rectangular, circular, I, T sections.

CO 4: Solve the equations of slope and deflection for different support arrangements by double integration method, Macaulay's method.

CO 5: Determine stresses induced in cylinders subjected to internal, external pressures.

UNIT– I

SIMPLE STRESSES & STRAINS: Concept of stress and strain- Types of stresses & strains- tensile, compressive, shear –Hooke's law – stress – strain diagram for mild steel – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying cross section – composite bars. Elastic moduli and the relationship between them. Temperature stresses.

STRAIN ENERGY & IMPACT LOADING: Strain energy - Resilience – Stress due to various types of axial loads- Gradually applied suddenly applied and impact loadings.

UNIT–II

SHEAR FORCE AND BENDING MOMENT: Definition of beam – Types of beams - concepts of SF & BM with point load, Uniformly Distributed Load, 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: Theories of simple bending – Assumptions - derivation of bending equation, - Neutral axis, Moment of resistance, determination of bending stresses, section modulus of rectangular and circular sections (solid and hallow), I & T sections.

SHEAR STRESSES: Shear stress distribution across various beams sections- rectangular, circular, I and T sections.

UNIT-IV

DEFLECTION OF BEAMS: Member bending into a circular arc –slope, deflection and radius of curvature. Determination of slope and deflection for cantilever and simply supported beams subjected to point loads and U.D.L by Double integration method, Macaulay's method, Moment area method.

UNIT-V

THIN CYLINDERS: Thin cylinders - longitudinal and circumferential stresses, Derivation of formulae and calculations of hoop stress, longitudinal stress in a cylinder subjected to internal pressure

THICK CYLINDERS: Derivation of formulae for radial and hoop stresses, Lame's equation, cylinders subjected to inside & outside pressure, compound cylinders.

TORSION OF SHAFTS: Theory of pure torsion, Torsional moment of resistance, derivation of Torsion equation, assumptions in the theory of pure torsion, polar modulus, power transmitted by a circular shaft, shafts in series, shafts in parallel.

TEXT BOOKS:

1. Mechanics of Materials by B.C. Punmia, Ashok Kumar Jain, Arun Kumar
2. Strength of materials by S. Ramamrutham, Dhanpat Rai Publications.
3. Strength of materials by R. K. Bansal, Lakshmi publications

REFERENCE BOOKS:

1. Introduction to solid mechanics by Irving H. Shames, James M. Pitarresi, Pearson Publications.
2. Mechanics of Materials (In Si Units) by Beer and Johnson, Tata McGraw-Hil.
3. Strength of Materials (Mechanics of Materials) by James M.Gere and Barry J.Goodno, PWS-KENT Publishing Company, 1990
4. Strength of Materials (Mechanics of Solids) by R.K. Rajput, S.Chand Publications.

WEB REFERENCES:

1. URL: https://nptel.ac.in/courses/112107146/23
2. https://nptel.ac.in/courses/105105108/19
3. https://nptel.ac.in/courses/112105125/pdf/module-9%20lesson-2.pdf
4. https://nptel.ac.in/courses/112105164/36

E-BOOKS: 1. https://easyengineering.net/a-textbook-of-strength-of-materials/

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME21L1	**FLUID MECHANICS AND HYDRAULIC MACHINERY LAB**						

COURSE OBJECTIVE:

- To impart practical exposure on the performance evaluation methods of various flow measuring equipment and hydraulic turbines and pumps.

COURSE OUTCOMES:

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

CO 1: Experiment with the flow discharge measuring devices used in pipes, channels and tanks.
CO 2: Solve the flow equations to estimate performance of the pump
CO 3: Evaluate the friction factor of a pipe flow
CO 4: Apply conservation principles to hydraulic machines

LIST OF EXPERIMENTS:

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orifice meter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.

VIRTUAL LAB: (www.vlabs.co.in)

1. Verification of Bernoulli's theorem
2. Reynolds experiment for determination of different regimes of flow.

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME21L2	**MECHANICS OF SOLIDS AND METALLURGY LAB**						

COURSE OBJECTIVES:

- In this laboratory students will have the opportunity to apply loads to various materials under different equilibrium conditions. The student will perform tests on materials in tension, compression, torsion, and impact.
- To impart practical exposure on the microstructures of various materials and their hardness evaluation. Also to impart practical knowledge on the evaluation of material properties through various destructive testing procedures.

COURSE OUTCOMES:

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

CO 1: Experiment with different materials for the evaluation of material properties through various destructive testing procedures.

CO 2: Examine the microstructures of different materials and also identify the hardness values.

NOTE: Any 6 experiments from section A and B.

(A) MECHNICS OF SOLIDS LAB:

1. Tension test on brittle and ductile materials
2. Fatigue Test
3. Specimen preparation and characterization
4. Torsion test
5. Hardness Test (Brinell's, Vickers and Rockwell's)
6. Test on springs
7. Compression test on cube
8. Impact test – Charpy & Izod
9. Deflection of Simply Supported beam
10. Deflection of Cantilever beam
11. Die Penetrant test

Virtual Lab: (www.vlabs.co.in)

1. To obtain strain measurement for Aluminium specimen by conducting creep test.

(B) METALLURGY LAB:

I. Preparation and study of the Micro Structure of Ferrous materials

a) Cast Iron

1. Grey cast iron
2. Nodular cast iron
3. White cast iron

b) Steel

1. Mild steel
2. Low carbon steel
3. High carbon Steel

II. Preparation and study of the Micro Structure of Non-Ferrous materials-

1. Brass
2. Aluminium
3. Copper
4. Hardenability of steels by Jominy End Quench Test.
5. Die penetration Test.

Virtual Lab: (www.vlabs.co.in)

1. Investigate Mechanical properties of Nano material by conducting Nano indentation test.

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME21L3	**METROLOGY AND INSTRUMENTATION LAB**						

COURSE OBJECTIVES:

- The Metrology and instrumentation Laboratory course is designed for measuring and gauging instruments for inspection of precision linear, geometric forms, angular and surface finish measurements.
- The student can learn the measurements with and calibration of instruments. Instrumentation lab introduces the students with the theory and methods for conducting experimental work in the laboratory and calibration of various instruments for measuring pressure, temperature, displacement, speed, etc.

COURSE OUTCOMES:

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

CO1: Examine different instruments that are available for linear, angular and roughness measurements and select and use the appropriate measuring instrument according to a specific requirement.

CO2: Analyze proper measuring instrument and know the requirement of calibration, errors in measurement.

METROLOGY LAB:

1. Measurement of lengths, heights, diameters by Vernier calipers, micrometers.
2. Measurement of bores by internal micrometers and dial bore gauge.
3. Use of gear tooth Vernier caliper for tooth thickness inspection and flange micro meter for checking the chordal thickness of spur gear.
2. Machine tool alignment test on the lathe, drilling & milling machines.
3. Angle and taper measurements with bevel protractor, Sine bars, rollers and balls.
4. Use of spirit level in finding the straightness of a bed and flatness of a surface.
5. Thread inspection with two wires/ three wire method & tool maker's microscope.
6. Surface roughness measurement with roughness measuring instrument.

INSTRUMENTATION LAB:

1. Calibration of pressure gauge.
2. Calibration of thermocouple for temperature measurement.
3. Calibration of Resistance Temperature Detector for temperature measurement.
4. Study and calibration of LVDT transducer for displacement measurement.
5. Calibration of strain gauge.
6. Calibration of thermistor for temperature measurement.
7. Calibration of capacitive transducer.
8. Study and calibration of photo and magnetic speed pickups.
9. Calibration of resistance temperature detector.

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	4	-	50	50	2
Code: R20ME21SC1	**SOLID MODELLING**						

COURSE OBJECTIVE:

- This course will give the insight into the design, creation of assembly and get the detailed drawing of machine components. To enhance the student's knowledge and skills in engineering drawing and to introduce drafting packages and commands for computer aided drawing and modelling
- The course in intended to provide knowledge of Create Simple Extruded Solid Models, understand the Basic Parametric modelling and Create and Edit Parametric Dimensions.

COURSE OUTCOMES:

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

CO1: Create a model machine parts by using software packages

CO2: Create Simple Extruded Solid Models, understand the Basic Parametric modelling and Create and Edit Parametric Dimensions

Syllabus: Introduction about 3D Modelling Software. Interface, Sketch Tools, View Tool bar, Profile Tool bar, Operation Tool bar, Tools, Constrain tool bar, Transformation Tool bar, User Selection Filter, Standards, Visualizations. Sketch Based Features, Dress up Features, Transformation Features, Reference Elements, Measure, Thickness, Boolean Operations. Introduction to Geometric Dimensioning and Tolerance, Weld Symbols, GD&T Symbols, types of Tolerances, Types of views, Roughness Symbols.

LIST OF EXPERIMENTS: To model -

1. Two dimensional components
2. Shaft support, centering bearing, motor bracket
3. A component according to dimensions using sketcher module.
4. A component according to dimensions using part design module.
5. The components and assemble according to dimensions using assembly module
6. A component according to dimensions using sheet metal design module.
7. A component according to dimensions using in sketcher and surface design module.
8. Machine Components by using Drafting module.
9. Layout using Drafting module.

To mention -

10. Geometry Dimensioning using Drafting module.

Resources:

1. http://www.staff.city.ac.uk/~ra600/ME2105/Catia%20course/CATIA%20Tutorials/prtug_C2/prtuggs01.htm
2. http://www.staff.city.ac.uk/~ra600/ME2105/Catia%20course/CATIA%20Tutorials/asmug_C2/asmuggs01.htm
3. http://www.staff.city.ac.uk/~ra600/ME2105/Catia%20course/CATIA%20Tutorials/wfsug_C2/wfsuggs01.htm
4. http://www.staff.city.ac.uk/~ra600/ME2105/Catia%20course/CATIA%20Tutorials/draug_C2/drauggs01.htm

II B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	0	0	-	-	-	0
Code: R20CC21MC1	**ENVIRONMENTAL STUDIES (Common to all Branches)**						

COURSE OBJECTIVES:

- To make the students aware about the environment and it's inter–disciplinary, to familiarize the concept of ecosystem and their importance, basic understanding of the ecosystem and its diversity.
- Overall understanding of the natural resources.
- To bring the awareness among students about the importance of biodiversity and the need for its conservation.
- To make the students understand the adverse effects of environmental pollution, its causes and measures to control it.
- Acquaintance on various environmental challenges induced due to unplanned anthropogenic activities. Awareness on the social issues, environmental legislation and global treaties understanding the environmental policies and regulations.

COURSE OUTCOMES:

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

CO1: Explain the concepts of the ecosystem and its function in the environment. The need for protecting the producers and consumers in various ecosystems and their role in the food web.

CO2: Analyze the natural resources and their importance for the sustenance of the life and recognize the need to conserve the natural resources.

CO3: Explain the biodiversity of India and the threats to biodiversity, and conservation practices to protect the biodiversity.

CO4: Distinguish various attributes of the pollution, their impacts and measures to reduce or control the pollution along with waste management practices.

CO5: Define Environmental policy, legislation, environmental assessment and the stages involved in EIA Environmental audit.

UNIT – I

Multidisciplinary nature of Environmental Studies: Definition, Scope and Importance – Need for Public Awareness. Institutions and people in Environment.

Ecosystems: Definitions and concepts – Characteristics of ecosystem – Structural and functional features – Producers, consumers and decomposers and food webs – Types of ecosystems – Forests, grassland, desert, crop land, pond, lake, river and marine ecosystems – Energy flow in the ecosystem – Ecological pyramids – Ecological successions.

UNIT – II

Natural Resources: Water resources–Use and over utilization of surface and natural resourced ground water–Floods, drought, conflicts over water, dams–benefits and problems on tribal population & Environment.

Forest resources: Use and over–exploitation, deforestation.

Mineral resources: Use and exploitation, tribal & environmental effects of extracting and using mineral resources.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of

modern agriculture, fertilizer–pesticide problems, water logging, salinity–concept of sustainable agricultural methods.

Energy Resources: Renewable (wind energy, tidal energy) and non renewable energy resources (Fossil fuels, coal).

UNIT – III

Biodiversity: Definition: genetic, species and ecosystem diversity- classification - Value of biodiversity: consumptive use, productive use, social-Biodiversity at national and local levels. India as a mega-diversity nation - Hot-spots of biodiversity

Conservation of biodiversity: Threats to biodiversity: habitat loss, man wildlife conflicts - Endangered and endemic species of India – Conservation of biodiversity: In-Situ conservation and Ex- situ conservation.

UNIT – IV

Environmental Pollution and Control Technologies: Definition, Cause, effects and control measures of Air pollution, Water pollution, Soil pollution, Noise pollution, and nuclear hazards. Role of an individual in prevention of pollution. - Pollution case studies, Good Agricultural Practices – Drip irrigation, soil erosion and desertification.

Solid Waste Management: Sources, Classification, effects and control measures of urban and industrial solid wastes. Consumerism and waste products, Biomedical, Hazardous and e – waste management.Covid-19- and environmental Health –Impact of the Coronavirus-Precautions and infection control.

UNIT – V

Environmental Policy, Legislation and Environmental Management: Environmental ethics: Issues and possible solutions. Environmental Protection Act, Legal aspects -Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act - Wildlife Protection Act -Forest Conservation Act-Issues involved in enforcement of environmental legislation.

Impact Assessment and its significance - various stages of EIA, preparation of EMP and EIS, Environmental audit, Ecotourism.

Visit to some local Polluted Site: Study of an industrially Polluted area.

TEXT BOOKS:

1. AnubhaKaushik& C. P. Kaushik, Environmental Studies,NewAge International (P) Ltd., New Delhi. Fourth edition,2014.
2. P. N. Palanisamy, P. Manikandan, A. Geetha, and K. ManjulaRani,Environmental Studies, Pearson Education, Chennai.ISBN 978-93-325-2052-3,Secondedition-2014.

REFERENCE BOOKS:

1. Deekshita Dave & P. UdayaBhaskar, Text Book of Environmental Studies CengageLearning.
2. Shaashi Chawla, a Textbook of Environmental Studies, TMH, NewDelhi.
3. Benny Joseph Environmental Studies, Tata McGraw Hill Co, NewDelhi.
4. Dr.K.V.S.G. Murali Krishna, Environmental Studies VGS Publishers, Vijayawada, First Edition2016.
5. Bharucha, E. Text book of Environmental Studies, First edition, Universities Press (India) Pvt., Ltd., Hyderabad,2005.

Web References:

1. URL:https://www.youtube.com/watch?v=7G3eXI_DPn8
2. URL: https://www.eolss.net/sample-chapters/C09/E6-70-05-01.pdf

3. URL: https://www.youtube.com/watch?v=QuRL6NbyvEQ
4. URL: https://google/ Introduction to Environmental Studies5JM1G2
5. URL:http://www.teacherspayteachers.com/Product/Food-Chains-Trophic-Levels-and-Ecological-Pyramids-PowerPoint Click theabove
6. URL:http://iadc-dredging.com/en/371/environment/ecosystem-services/ this webinar will focus on the concept of ecosystemservices
7. URL: http://mocomi.com/ presents: What is Air Pollution? Air pollution is the introduction of foreign products into theatmosphere.
8. URL: https://en.wikipedia.org/wiki/green_impact_assessment

E-books:

1. https://faculty.psau.edu.sa/.../doc-5-pdf-d78456fce3bebc84d9320fa2f9cf9e2a-original
2. https://www.researchgate.net/.../273775623_Introduction_to_Environmental_Sciences

II B.TECH– II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Applied Thermodynamics	R20ME2204	ES	30	70	100	2	1	0	3
2	Complex Variables Probability and Statistics	R20CC2202	BS	30	70	100	2	1	0	3
3	Kinematics of Machinery	R20ME2205	PC	30	70	100	3	0	0	3
4	Manufacturing Technology	R20ME2203	PC	30	70	100	3	0	0	3
5	Technical and Communicative English –II	R20CC2201	HS	30	70	100	3	0	0	3
6	Machine Drawing Lab	R20ME22L1	PC	15	35	50	0	0	3	1.5
7	Applied Thermodynamics Lab	R20ME22L2	PC	15	35	50	0	0	3	1.5
8	Manufacturing Technology Lab	R20ME22L3	PC	15	35	50	0	0	3	1.5
9	Computer Aided Engineering Practice	R20ME22SC2	SC	-	50	50	0	0	4	2
									Total	**21.5**
10	Honors/Minors Course	-	HC	30	70	100	4	0	0	4

II B.TECH	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
II SEMESTER	2	1	0	30	70	100	3
Code: R20ME2204	**APPLIED THERMODYNAMICS**						

COURSE OBJECTIVES:

- To learn and understand the reasons and affects of various losses that occur in the actual engine operation.
- To understand the engine terminology and working principles of I.C Engines.
- To learn analytical techniques to the engineering problems and performance analysis of internal combustion engines.
- To learn the design and operating characteristics of modern internal combustion engines.

COURSE OUTCOMES:

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

CO 1: Illustrate the reasons and effects of various losses that occur in the actual engine operation.
CO 2: Analyze the combustion phenomenon and knocking in SI and CI engines
CO 3: Explain the performance and emission parameters of SI and CI engines
CO 4: Evaluate the parameters of performance and measurement of IC engines.
CO 5: Examine the working of different types of compressors.

UNIT – I

Actual Cycles and their Analysis: Introduction, Comparison of Air Standard and Actual Cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blowdown-Loss due to Gas exchange process, Volumetric Efficiency. Loss due to Rubbing Friction, Actual and Fuel-Air Cycles of CI Engines.

UNIT – II

I. C. ENGINES: Classification - Working principles, Valve and Port Timing Diagrams, - Engine systems – Fuel, Carburettor, Fuel Injection System, Ignition, Cooling and Lubrication systems, principle of Wankel engine, principles of supercharging and turbo charging.

UNIT – III

Combustion in S.I. Engines: Normal Combustion and abnormal combustion – Importance of flame speed and effect of engine variables – Types of Abnormal combustion, pre-ignition and knocking– Fuel requirements and fuel rating, anti-knock additives – combustion chamber – requirements, types.

Combustion in C.I. Engines: Four stages of combustion – Delay period and its importance – Effect of engine variables – Diesel Knock– Need for air movement, suction, compression and combustion induced turbulence – open and divided combustion chambers and nozzles used – fuel requirements and fuel rating.

UNIT – IV

Measurement, Testing and Performance of IC Engine: Parameters of performance - measurement of cylinder pressure, fuel consumption, air intake, exhaust gas composition, Brake power – Determination of frictional losses and indicated power – Performance test – Heat balance sheet and chart.

UNIT – V

COMPRESSORS – Classifications (Positive displacement type): Roots Blower, vane sealed compressor, Lysholm compressor – Dynamic Compressors – Centrifugal compressors: Mechanical details and principle of operation– Reciprocating Principle of operation, multi stage compression, minimum work condition for two stage compression. And rotary types. Axial Flow Compressors: Mechanical details and principle of operation, work done factor - isentropic efficiency.

TEXT BOOKS:

1. I.C. Engines by V. Ganesan- TMH
2. Heat engines by Vasandani & D S Kumar, Dhanpath Rai & Sons

REFERENCES:

1. Thermal Engineering by RK Rajput, Lakshmi Publications
2. Thermal Engineering by R.S.Khurmi & J.S.Gupta, S.chand Publications

Web References:

1. https://dieselnet.com/tech/diesel_fundamentals.php
2. https://nptel.ac.in/courses/112/103/112103262/
3. https://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2017/
4. https://books.google.co.in/books/about/Internal_Combustion_Engine_Fundamentals.html?id=u9FSAAAAMAAJ&redir_esc=y

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20CC2202	**COMPLEX VARIABLES, PROBABILITY AND STATISTICS (EEE and ME)**						

COURSE OBJECTIVES:

- To analyze the function of complex variable and its analytic property with a review of elementary complex function.
- To understand the Taylor and Laurent expansion with their use in finding out the residue and improper integral.
- To revise the elementary concepts of probability
- To introduce techniques for carrying out probability calculations and identifying probability distributions.

COURSE OUTCOMES:

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

CO1: Apply the probability concepts in their respective engineering data.
CO2: Apply discrete and continuous probability distributions to solve various engineering problems.
CO3: Analyze the multivariate problems in engineering.
CO4: Apply the method of least squares to estimate the parameters of a regression model.
CO5: Determine the confidence interval for a population parameter for single sample and two sample cases.

UNIT I: FUNCTIONS OF COMPLEX VARIABLES:

Limit and Continuity of f(z), Derivative of f(z), Cauchy-Riemann equations, analytic Functions, harmonic functions, Orthogonal system. Application: Flow problems.

UNIT II: COMPLEX INTEGRATION:

Integration of Complex functions, Cauchy theorem (without proof), Cauchy integral formula (without proof), Series of complex terms, Taylor's series, Laurent's series, zeros and singularities of analytic functions, residues and residue theorem(without proof), Calculation of residues. Applications: Evaluation of real definite integrals (Integration around the semi-circle and Unit Circle)

UNIT III: PROBABILITY AND RANDOM VARIABLES:

Probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous)**,** Binomial - Poisson approximation to the binomial distribution and normal distribution-their properties.

UNIT IV: SAMPLING DISTRIBUTION:

Estimation: Point Estimation, Interval Estimation, Bayesian Estimation.

UNIT V: TESTING OF HYPOTHESIS:

Formulation of null hypothesis, critical regions, level of significance.
Large sample tests: test for single mean test for single proportion.
Small Sample tests: Student t-distribution (single mean, two means and paired t-test), Testing of equality of variances (F-test), $\chi 2$ - test for goodness of fit, $\chi 2$ - test for independence of attributes.

TEXT BOOKS:

1. B.S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna Publishers.
2. Miller and Freund's, Probability and Statistics for Engineers, 7/e, Pearson, 2008.

REFERENCE BOOKS:

1. T. K. V. Iyenger, Probability and Statistics, S. Chand & Company Ltd, 2015.
2. Jay I. Devore, Probability and Statistics for Engineering and the Sciences, 8th Edition, Cengage.
3. S. C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, 11/e (Reprint) 2019, Sultan Chand & Sons Publications.

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME2205	**KINEMATICS OF MACHINERY**						

COURSE OBJECTIVES:

- To make student understand the purpose of kinematics, Kinematic joint and mechanism and to study the relative motion of parts in a machine without taking into consideration the forces involved.
- To make student understand various mechanisms for straight line motion and their applications including steering mechanism.
- To make student understand the velocity and acceleration concepts and the methodology using graphical methods and principles and application of four bar chain.
- To make student understand the theories involved in cams.
- To make student understand gears, gear trains.

COURSE OUTCOMES:

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

CO 1: Illustrate the various types of kinematic links, kinematic joints & mechanisms.
CO 2: Interpret the various types of lower pair mechanisms for engineering applications..
CO 3: Construct the velocity and acceleration diagram of different mechanisms.
CO 4: Construct the different CAM profiles under motion.
CO 5: Demonstrate the Gears and Gear Trains.

UNIT– I

MECHANISMS: Elements or Links – Classification of Links – Types of kinematic pairs –Types of constrained motion. Grubler's criteria, Grashoff's law, Degrees of freedom, Kutzbach criterion for planar mechanisms. Mechanism and machines – Classification of machines – kinematic chain – inversion of mechanism– inversions of quadric cycle, chain – single and double slider crank chains.

UNIT–II

LOWER PAIR MECHANISM: Exact and approximate copiers and generated types - Peaucellier, Hart and Scott Russul - Grasshopper - Watt T. Chebicheff and Robert Mechanisms and straight line motion, Pantograph. Conditions for correct steering - Davis Steering gear, Ackerman's steering gear - velocity ratio; Hooke's Joint: Single and double - Universal coupling- application-problems.

UNIT–III

KINEMATICS: Velocity and acceleration – Motion of a link in machine –Determination of Velocity and acceleration diagrams – Graphical method –Application of relative velocity method four bar chain. Velocity and acceleration analysis of a given mechanism, Klein's construction, Coriolis acceleration, 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.

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 and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above three cases, Analysis of motion of Roller follower

UNIT-V

GEAR: Higher pairs, friction wheels and toothed gears–types – law of gearing, condition for constant velocity ratio for transmission of motion, 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.

GEAR TRAINS: Introduction to gear Trains, Train value, Types – Simple and reverted wheel train – Epicyclic gear Train. Methods of finding train value or velocity ratio –Epicyclic gear trains.

TEXT BOOKS:

1. S.S.Ratan, Theory of Machines, Mc. Graw Hill Publ.
2. Thomas Bevan, Theory of Machines, CBS Publishers & Distributors

REFERENCE BOOKS:

1. Sadhu Singh, Theory of Machines , Pearsons Education
2. Khurmi, Theory of machines , S.Chand publications
3. Ashok G. Ambedkar, Mechanism and machine theory, PHI Publications.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/104/112104121/
2. http://www.nptelvideos.in/2012/12/kinematics-of-machines.html
3. https://nptel.ac.in/courses/112/105/112105268/
4. https://www.btechguru.com/GATE--mechanical-engineering--theory-of-machines-video-lecture--23--189.html

E-BOOKS:

1. https://www.pdfdrive.com/kinematics-of-machines-e19480301.html

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME2203	**MANUFACTURING TECHNOLOGY**						

COURSE OBJECTIVES:

- To emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes
- To understand the conventional manufacturing processes like casting, metal forming, and welding process.

COURSE OUTCOMES:

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

CO 1: Explain various manufacturing processes and fundamentals of casting process
CO 2: Outline different types of welding process for fabrication of metals
CO 3: Demonstrate advanced welding processes by make use of sketches
CO 4: Compare the characteristics of cold and hot working processes of Forming, forging and Rolling
CO 5: Explain principles of Extrusion and Drawing processes by make use of sketches

UNIT-I

INTRODUCTION TO MANUFACTURING PROCESSES: Difference between Production and Manufacturing.

FOUNDRY: Introduction to casting process, steps involved in making a casting, Advantages of casting and its applications, Electric furnaces. Types of patterns, Materials used for patterns, Pattern allowances, Gating elements and moulding procedure, Moulding materials, Cores, Types of Sand moulding-CO2 Moulding and Shell Moulding. Manufacturing of Plastic components: blow and injection moulding

SPECIAL CASTING METHODS: Permanent Mould Casting, Die Casting, Centrifugal Casting, Investment Casting, Continuous Casting, Fettling of Castings, Casting Defects: causes and remedies.

UNIT-II

WELDING: Classification of welding processes, Types of welds and types of joints.

GAS WELDING: Equipment, Oxy-Acetylene flame, types, Gas welding procedure, Gas cutting.

ARC WELDING: Principle of Arc welding, Equipment, Electrodes, Electrode coatings, AC and DC Welding, Arc Blow, Arc Length Characteristics, Related Simple Problems. Welding defects – Causes and Remedies.

UNIT-III

RESISTANCE WELDING: Principle, Butt welding, spot welding and seam welding. Simple problems on resistance welding.

OTHER WELDING PROCESSES: Thermit welding, Inert gas welding - TIG and MIG welding, submerged arc welding, plasma arc welding, soldering and brazing. Introduction to advanced welding technologies - laser welding, electron beam welding,

UNIT-IV

FORMING: Introduction, Elastic & Plastic deformation; Recovery, Recrystallization & grain growth; Hot working & Cold working. Sheet metal working

FORGING: Introduction, Hot forging & Cold forging, Open & Closed die forging, Forging defects & remedies.

ROLLING: Introduction, Hot & Cold rolling process, Angle of bite, rolling stand arrangements.

UNIT-V

EXTRUSION & DRAWING: Extrusion fundamentals, Classification of Extrusion- Forward Extrusion, Backward Extrusion, Impact extrusion, Hydrostatic extrusion. Types of drawing: Wire drawing, Tube drawing.

TEXT BOOKS:

1. Manufacturing Technology Vol-I by P.N. Rao, Tata McGraw Hill Publications.
2. Production Technology by P. C. Sharma, S. Chand Publications.

REFERENCES:

1. Welding Technology by Little byTata McGraw Hill Publications.
2. Manufacturing Engineering and Technology by Kalpak Jain, Pearson Education/PHI.

Web References:

1. https://nptel.ac.in/courses/112107144/1
2. https://nptel.ac.in/courses/112107144/2
3. https://nptel.ac.in/courses/112107144/10
4. https://nptel.ac.in/courses/112107144/13
5. https://nptel.ac.in/courses/112107144/14

E-Books:

1. https://easyengineering.net/manufacturingbooks/
2. https://easyengineering.net/manufacturingbooks/
3. https://books.google.com/books/about/Manufacturing_Technology.html?id=fSHZAgAAQBAJ
4. https://www.researchgate.net/publication/259800841_Manufacturing_Technology_Vol_1_Foundry_Forming_and_Welding

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC2201	**TECHNICAL AND COMMUNICATIVE ENGLISH-II**						

COURSE OBJECTIVES:

- To equip the students with appropriate oral and written communication skills.
- To inculcate the skills of listening, reading and critical thinking.
- To enhance the students' proficiency in reading skills enabling them meet the academic needs of their course.
- To enable the engineering students develop their basic communication skills in English for academic and social purposes.

COURSE OUTCOMES:

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

CO1: Infer explicit and implicit meaning of a text, recognize key passages; raise questions and summarize it**.**

CO2: Compose paragraphs, essays, emails, letters, reports, resume and transfer information into tables, Pie and bar diagrams.

CO3: Build grammatically correct sentences using a variety of sentence structures.

CO4: Enhance word power and usage of lexicons.

UNIT– I

A Proposal to Griddle the Earth, Nellie Bly

a) **Placement Papers**.
b) **Reading**: Skimming for main idea, scanning for specific piece of information.
c) **Writing**: Note – making flowed by paragraph writing, effective opening sentences, introducing the topic, key words, main idea, summarize the main idea.
d) **Grammar and Vocabulary**: Content words and function words, verbs, nouns, adjectives and adverbs. Basic sentence structure and simple question form, framing jargon, technical vocabulary (15 words)

UNIT–II

The District School As It Was by One who Went to It, Warren Burton

a) **Placement Papers.**
b) **Reading**: Identifying the sequence of ideas and recognizing verbal techniques to link the ideas in a paragraph.
c) **Writing**: Paragraph writing, using key words/phrases and organizing points in a coherent manner.
d) **Grammar and Vocabulary**: Linkers, articles and prepositions

UNIT–III

The future of Work- Jacob Morgan

a) **Placement Papers**.
b) **Reading**: Sequencing of ideas and recognizing verbal techniques to link the ideas in a paragraph.
c) **Writing**: Paragraph writing, using key words/phrases and organizing points in a coherent manner.
d) **Grammar and Vocabulary**: Cohesive devices, articles and prepositions.

UNIT-IV

H.G.Wells and the Uncertainties of Progress, Peter J. Bowler

a) **Placement Papers**.
b) **Reading**: Understand and interpret graphic elements used in texts.
c) **Writing**: Information transfer.
d) **Grammar and Vocabulary**: Adjectives, adverbs and antonyms.

UNIT-V

Leaves from the Mental Portfolio of a Eurasian, Sui Sin Far

a) **Placement Papers**.
b) **Reading:** Reading for comprehension.
c) **Writing**: Essay writing
d) **Grammar and Vocabulary**: Articles, prepositions, tenses, subject verb agreement and technical jargon (15 words)

TEXT BOOKS:

1. English All Round -I (Communication skills for Under Graduate Learners)– Orient Black Swan Pvt.Ltd.Publisher, 1st edition,2019

REFERENCE BOOKS:

1. Raymond Murphy, *Murphy's English Grammar,* Cambridge University Press 2004
2. Meenakshi Raman, Sangeeta Sharma, *Technical Communication: English Skills for Engineers*, Oxford University Press, 2009
3. Michael Swan, *Practical English Usage,* Oxford University Press, 1996

Web References:

1. https://www.grammarly.com/blog
2. https://www.englishclub.com/
3. www.nonstopenglish.com/
4. https://www.fluentu.com/blog/english/
5. https://beta.freerice.com/
6. https://prepinsta.com/cognizant/
7. https://www.geeksforgeeks.org/tcs-placement-paper-mcq-1/
8. https://www.firstnaukri.com/career-guidance/infosys-placement-papers-with-solutions-2019-firstnaukri-prep
9. https://in.usembassy.gov/education-culture/american-spaces/dostihouse-mumbai/library-services/
10. https://www.youtube.com/user/bbclearningenglish
11. https://www.cambridgeenglish.org/learning-english/free-resources/write-and-improve/
12. https://englishlive.ef.com/blog/language-lab/5-simple-ways-improve-written-english/

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME22L1	**MACHINE DRAWING LAB**						

COURSE OBJECTIVES:

- The student will acquire knowledge of fastening arrangements such as screw fasteners, keys & bearings.. The student also is enabled to prepare the assembly of various machine, engine components and valves.

COURSE OUTCOMES:

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

CO 1: Explain about sectional views, limits, fits and tolerances, screw fasteners, keys, cotter Joints, bearings.

CO 2: Construct assembly drawings of engine parts, machine pars, and valves

PART-A

I. DRAWING OF MACHINE ELEMENTS AND SIMPLE PARTS

A) Introduction: Full and half sectional views, limits, fits and tolerances.

B) Screwed fasteners: Screw thread nomenclature - types & classification of screw threads,

Square & Hexagonal headed bolted joints, Locking Arrangements for Nuts, Eye Foundation Bolt.

C) Keys, Cotters and Pin joints: Saddle & Sunk Keys, Cotter Joint with sleeve, Knuckle Joint.

D) Bearings: Journal, pivot and collar and foot step bearings

PART-B

II. ASSEMBLY DRAWING:

A) Engine parts: Stuffing Box, Eccentric, Steam Engine Crosshead

B) Other machine parts - Screws jacks, Machine Vices Plummer block, Tailstock.

C) Valves: Spring loaded safety valve, feed check valve and air cock, Control valves

TEXT BOOKS:

1. Machine Drawing by K.L.Narayana, P.Kannaiah & K.Venkata Reddy, New Age International 3rd Edition.
2. Machine Drawing by N.Siddeswar, K.Kannaiah & V.V.S.Sastry, TMH Publications

REFERENCE BOOKS:

1. Machine Drawing by K.R.Gopala Krishnan, Subhas Publications, 20th Edition, 2007.
2. Machine Drawing by KC John, PHI Publications

Web References:

1. https://www.youtube.com/results?search_query=machine+drawing+assembly+parts

E-Books:

1. https://books.google.co.in/books?id=gxXAgONCd8cC&newbks=1&newbks_redir=0&printsec=frontcover&source=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME22L2	**APPLIED THERMODYNAMICS LAB**						

COURSE OBJECTIVE:

- To provide hands on experience in operating various types of internal combustion engines and understand their functioning and performance.

COURSE OUTCOMES:

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

CO 1: Examine the performance and emission parameters of SI and CI engines.
CO 2: Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol engine.
CO 3: Analyze Performance test on reciprocating air compressor unit.

LIST OF EXPERIMENTS:

1. I.C. Engines valve & port timing diagrams.
2. Testing of Fuels – Viscosity, flash point/fire point, carbon residue, calorific value.
3. I.C. Engines performance test and Exhaust emission measurements (4 -stroke diesel engine)
4. I.C. Engines performance test and Exhaust emission measurements (2-stroke petrol engine)
5. Evaluation of engine friction by conducting Morse test on 4-stroke multi cylinder petrol engine.
6. Determination of FP by retardation and motoring test on IC engine.
7. I.C. Engines heat balance at different loads and show the heat distribution curve.
8. Economical speed test of an IC engine.
9. Performance test on variable compression ratio engines.
10. Performance test on reciprocating air compressor unit.
11. Dis-assembly / assembly of different parts of I.C. Engine covering 2-stroke and 4 stroke, SI and CI engines.

II B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME22L3	**MANUFACTURING TECHNOLOGY LAB**						

COURSE OBJECTIVES:

- To apply the class room knowledge to do the experiments in the lab
- To identify and solve the problems while doing the experiments of casting, metal forming & casting and welding processes.

COURSE OUTCOMES:

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

CO 1: Prepare and Test different green sand mold and welding jojnts.

CO 2: Experiment on injection molding machines and different mechanical presses.

LIST OF EXPERIMENTS:

I. MOLDING PRACTICE:

1. Preparation of a green sand mould using single piece pattern.
2. Preparation of a green sand mould using multi piece pattern.
3. Sand testing: green strength, dry strength, grain fineness number, permeability etc.

II. WELDING PRACTICE:

1. Preparation of a T joint using electric arc welding.
2. Preparation of a Butt Joint using gas welding.
3. Preparation of a lap joint using spot welding.

III. PLASTIC MOLDING:

Injection Molding:

1. Preparation of a key chain by using two plate mold.

Blow Molding:

1. Preparation of a bottle by using blow molding technique.

IV. MECHANICAL PRESSES:

1. Preparation of a rodbends using hydraulic press.
2. Preparation of a washer using hydraulic press.

V. DEMONSTRATION OF STIR CASTING MACHINE:

1. Preparation of Aluminum casting with stir casting machine

VIRTUAL LAB:

1. Metal Forming Virtual Simulation Lab (http://msvs-dei.vlabs.ac.in/)

II B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	4	-	50	50	2
Code: R20ME22SC2	**COMPUTER AIDED ENGINEERING PRACTICE**						

COURSE OBJECTIVE:

- Candidates are trained on the simulation software to gain the first-hand experience of simulation and analysis of mechanical systems.
- Programmes were developed to enhance the skill set of the students on functions of engineering components and modules.

COURSE OUTCOMES:

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

CO1: Solve simple structural, heat and fluid flow problems using standard FEA software.

CO2: Analyzing of various components using analytical tools like ANSYS, Fusion 360 for engineering simulation.

LIST OF EXPERIMENTS:

SIMULATION LAB:

1. Determination of deformation and Member forces of a given 2D truss.
2. Calculation of the deflection, maximum & minimum stresses induced in a given cantilever beam.
3. Estimation of natural frequencies and mode shapes Harmonic response of 2D beam.
4. Determination of deflections of a component and principal and Von-mises stresses in plane stress, plane strain.
5. Determination of deflections of a component and principal and Von-mises stresses in Axisymmetric components.
6. Steady state heat transfer Analysis of plane and Axisymmetric components.
7. Stress analysis of flat plates
8. Stress analysis of simple shells
9. Vibration analysis of Spring Mass System.
10. Stress analysis of Hyper Elastic Material.

RESOURCES:

1. https://cloud.academy.3ds.com/r2017x/role_smq.html
2. https://forums.autodesk.com/t5/fusion-360-design-validate/pdf-user-manual-for-fusion-360-ultimate/td-p/5414813

III B.TECH – I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Artificial Intelligence and Machine Learning	R20ME3101	PC	30	70	100	3	0	0	3
2	Heat Power Engineering	R20ME3102	PC	30	70	100	2	1	0	3
3	Design of Machine Elements-I	R20ME3103	PC	30	70	100	2	1	0	3
4	**Open Elective Course/Job Oriented Elective -I**		OE	30	70	100	3	0	0	3
	RPT &3D Printing (Other than ME)	R20CC1OE06								
	Operations Research	R20CC1OE07								
5	**Professional Elective Course -I**		PC	30	70	100	3	0	0	3
	Automobile Engineering	R20ME3105								
	Refrigeration & Air Conditioning	R20ME3106								
	Metal Cutting & Machine Tools	R20ME3107								
	Work Study	R20ME3108								
6	Artificial Intelligence and Machine Learning Lab	R20ME31L1	PC	15	35	50	0	0	3	1.5
7	Heat power Engineering Lab	R20ME31L2	PC	15	35	50	0	0	3	1.5
8	Robotics & 3D Printing Lab	R20ME31SC3	SC	-	50	50	0	0	4	2
9	PE&HV	R20CC31MC01	MC				2	0	0	0
10	Internship/ Community Service Project	R20CC31IN	SI	-	50	50	0	0	3	1.5
									Total	**21.5**
11	Honors / Minors Course	-	HC	30	70	100	4	0	0	4

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME3101	**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING**						

COURSE OBJECTIVES:

- Develop a basic understanding of the building blocks of AI as presented in terms of intelligent agents: Search, Knowledge representation, inference, logic and learning.
- Develop and interpret different machine learning algorithms with Python based programming applications.

COURSE OUTCOMES:

After completion of this course, the students would be able to

CO 1: Summarize the characteristics of AI that make it useful to real-world problems. [K2]
CO 2: Analyze different search techniques and predicate logic in artificial Intelligence. [K3]
CO 3: Interpret knowledge representation and symbolic reasoning using different rules. [K2]
CO 4: Apply the basic knowledge on learning and reinforcement learning. [K3]
CO 5: Explore different machine learning algorithms [K3]

UNIT-I

INTRODUCTION TO ARTIFICIAL INTELLIGENCE: AI problems, foundation of AI and history of AI intelligent agents: Agents and Environments, the concept of rationality, the nature of environments, structure of agents, problem solving agents, problem formulation.

UNIT-II

SEARCH ALGORITHMS: Uninformed(Blind) type- Breadth-first search, Uniform cost search, Depth-first search, Informed Search; Informed type-Greedy Search, A* Search, Graph Search.

UNIT-III

KNOWLEDGE REPRESENTATION IN AI: Procedural versus declarative knowledge, logic programming, forward versus backward programming.

PYTHON FOR MACHINE LEARNING: Python data Types, Control Structure, Data manipulation using Numpy, Pandas and Matplotlib. Pre-processing steps of Machine Learning-Data quality assessment, Data cleaning, Data transformation and Data reduction.

UNIT-IV

MACHINE LEARNING: Definition, Evaluation, need, types, Applications, Supervised Learning:- Classification, Regression; Un-supervised Learning: - Clustering, Density Estimation, Dimensionality reduction.

UNIT-V

MACHINE LEARNING ALGORITHMS: Classification, Regression, KNN, K Means, Logistic, Regression, Support, Vector Machines (SVM), Decision Tree, Naïve Bayes, Ensemble Methods, Random Forest algorithms.

TEXT BOOKS:

1. Elaine Rich & Kevin Knight, Artificial Intelligence, Tata McGraw Hill Publishers
2. Machine Learning Tom M. Mitchell, Tata McGraw Hill Edition Publishers
3. Machine Learning with Python, Abhiskek Vijayvargia, BPB Publications

REFERENCE BOOKS:

1. Artificial Intelligence- Saroj Kaushik, CENGAGE Learning,
2. Applications of Machine Learning, Chandra Bansal, Kusum Deep, Springer Publications

WEB REFERENCES

1. https://www.coursera.org/learn/machine-learning
2. https://www.simplilearn.com/big-data-and-analytics/machine-learning
3. https://www.appliedaicourse.com/course/applied-ai-course-online
4. https://www.ibm.com/cloud/learn/machine-learning
5. http://nptel.ac.in/courses/106105152

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20ME3102	**HEAT POWER ENGINEERING**						

COURSE OBJECTIVES:

The course content enables students to:

- Inculcate the fundamental knowledge of the thermal power generation using steam and gas turbines.
- Discuss various types of rockets and its applications and preparation of rocket fuels and propellants.

COURSE OUTCOMES:

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

CO1: Illustrate the various types of efficiency improvements of Rankine cycle
CO2: Describe the various boilers, mountings and accessories.
CO3: Identify different types of nozzles used in steam turbines.
CO4: Classify different turbines based on utility and applications.
CO5: Discuss gas turbines, jet propulsion and rocket propulsion.

UNIT – I:

STEAM POWER PLANT: Rankine cycle - Schematic layout, Thermodynamic Analysis, Concept of Mean Temperature of Heat addition, Methods to improve cycle performance – Regeneration & reheating.

COMBUSTION: Fuel Types and combustion, concepts of heat reaction, adiabatic flame temperature, flue gas analysis- Orsat apparatus analysis.

UNIT - II:

BOILERS: Classification – Working principles with sketches including LP & H.P .Boilers – Mountings and Accessories – Working principles- Boiler horse power, Equivalent Evaporation, Efficiency and Heat balance.

DRAUGHT: Classification – Forced Draught and Natural Draught, Height of chimney for given draught and discharge- Condition for maximum discharge- Efficiency of chimney.

UNIT – III:

STEAM NOZZLES: Stagnation Properties- Function of nozzle – Applications and Types- Flow through nozzles- Thermodynamic analysis – Assumptions -Velocity of nozzle at exit-Ideal and actual expansion in nozzle- Velocity coefficient- Condition for maximum discharge- Critical pressure ratio-Criteria to decide nozzle shape- Super saturated flow, its effects, Degree of super saturation and Degree of under cooling - Wilson line.

UNIT – IV:

STEAM TURBINES: Classification – Impulse turbine, Mechanical details – Velocity diagram – Effect of friction – Power developed, Axial thrust, Blade or diagram efficiency – Condition for maximum efficiency. De-Laval Turbine - its features- Methods to reduce rotor speed-Velocity compounding and Pressure compounding.

REACTION TURBINE: Mechanical details – Principle of operation, Thermodynamic analysis of a stage, Degree of reaction –Velocity diagram – Parson's reaction turbine – Condition for maximum efficiency.

UNIT -V:

GAS TURBINES: Simple gas turbine plant – Ideal cycle, essential components – Parameters of performance – Actual cycle – Regeneration, Inter cooling and Reheating –Closed and Semi-closed cycles – Merits and Demerits.

JET PROPULSION: Principle of Operation –Classification of jet propulsive engines – Working Principles with schematic diagrams and representation on T-S diagram - Thrust, Thrust Power and Propulsion Efficiency, Turbo jet – Schematic Diagram, Thermodynamic Cycle, and Performance Evaluation.

TEXT BOOKS:

1. Thermal Engineering / Mahesh M Rathore/ Mc Graw Hill
2. Gas Turbines – V. Ganesan /Mc Graw Hill

REFERENCE BOOKS:

1. Gas Turbine Theory/ Saravanamuttoo, Cohen, Rogers/ Pearson
2. Fundamentals of Engineering Thermodynamics / Rathakrishnan/ PHI
3. Thermal Engineering/ Rajput/ Lakshmi Publications
4. Thermal Engineering/R.S. Khurmi / S.Chand Publications

WEB REFERENCES:

1. http://home.iitk.ac.in/~suller/lectures/lec29.htm
2. https://nptel.ac.in/courses/112/103/112103277/
3. http://nptelvideos.com/video.php?id=1181
4. http://150.107.117.36/NPTEL_DISK4/NPTEL_Contents/Web_courses/Phase1_web/112104117/machine/ui/Course_home-lec24.htm
5. https://nptel.ac.in/courses/112/106/112106166/

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20ME3103	**DESIGN OF MACHINE ELEMENTS-1 (Design Data Book is Allowed)**						

COURSE OUTCOMES:

CO1: Analyze the design considerations and stresses in machine members.
CO2: Solve the problems related to strength of machine elements.
CO3: Apply the engineering principles for the design of simple engineering machine members such as riveted joints, welded joints,
CO4: Apply the engineering principles for the design of keys, cotters, knuckle joints and power transmission of joints.
CO5: Solve the problems related to shaft coupling.

UNIT – I:

INTRODUCTION: General considerations in the design, engineering materials and their properties selection –Manufacturing consideration in design, tolerances and fits –BIS codes of steels.
STRESSES IN MACHINE MEMBERS: Simple stresses combined stresses, torsional and bending stresses, impact stresses, stress-strain relation, various theories of failure, factor of safety, design for strength and rigidity, preferred numbers.

UNIT – II:

STRENGTH OF MACHINE ELEMENTS:
Stress concentration, theoretical stress concentration factor, fatigue stress concentration factor notch sensitivity, design for fluctuating stresses, endurance limit, estimation of endurance strength, Soderberg's line, Goodman's line, modified Goodman's line.

UNIT – III:

RIVETED AND WELDED JOINTS: Riveted joints- types, failure of joints, and efficiency of joint. Welded joints-types of welded joints, strength of butt, parallel fillet and transverse fillet welded joints stresses.

UNIT – IV:

KEYS & COTTERS: Types of keys, force acting on keys, Design of Keys. Types of Cotter joint-Socket & Spigot joint, Sleeve & Cotter joint.
MECHANICAL SPRINGS: Types of springs, Stresses and deflections of helical springs, extension and compression of springs, springs for fatigue loading, energy storage capacity.

UNIT – V:

POWER TRANSMISSION SHAFTS: Design of shafts. Shafts subjected to bending, torsion and axial loading. Shafts subjected to Fluctuating loads.
SHAFT COUPLING: Rigid couplings-muff, split muff and flange couplings, flexible couplings-flange coupling (modified).

TEXT BOOKS:

1. Design of Machine Elements, V.B.Bhandari, TMH Publishing Co. Ltd., New Delhi.
2. Mechanical Engineering Design, J.E.Shigley, TMH Publishing Co. Ltd., New Delhi.

REFERENCES:

1. Machine Design, Pandyah and Shah, TMH Publishing Co. Ltd., New Delhi.
2. Design Data hand book. Mahadevan, CBS Publishers.
3. Machine Design, R.S. Khurmi & J.K.Gupta, S. Chand Publications.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/105/112105124/
2. https://nptel.ac.in/courses/112/105/112105125/
3. https://nptel.ac.in/courses/112/106/112106137/
4. http://www.nptelvideos.in/2012/12/design-of-machine-elements.html
5. https://freevideolectures.com/course/2363/design-of-machine-elements-i

III B.TECH I SEMESTER Professional Elective-I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME3105	**AUTOMOBILE ENGINEERING**						

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

CO1: Identify chassis models for different automobile applications.

CO2: Understand the concept of Ignition and Fuel supply.

CO3: Estimate suitable conventional and automatic transmission system, contrast steering, braking and suspension systems

CO4: Identify the usage of Electrical vehicles / Hybrid vehicles and power plants.

CO5: Predict the formation of pollution and its control methods.

UNIT – I:

INTRODUCTION: Vehicle construction, Chassis and body, Specifications, Engine Types-Construction, Location of engine, Cylinder arrangement , Construction details, Cylinder block, Cylinder head, Cylinder liners. Lubrication system, Types, Oil pumps, Filters, Cooling system - types, Water pumps, Radiators, Thermostats, Anti-freezing compounds.

UNIT – II:

IGNITION, FUEL SUPPLY: Ignition system, Coil and Magneto, Spark plug, Distributor, Electronic ignition system, Battery, Generator, Starting Motor, and Ignition Fuel system, Carburetor, Fuel pumps, Fuel injection systems, Mono point and Multi point, Unit injector, Nozzle types, Electronic Fuel Injection system, MPFI, DTSI.

UNIT – III:

TRANSMISSION SYSTEM:

CLUTCHES- Function, Types, Single plate, multiple plate, Fluid coupling.

GEARBOX - Sliding, Constant, Synchromesh, Overdrive, Torque converter, automatic transmission system – Epicylic.

PROPELLER SHAFT - Hotchkiss drive, Final drive, Rear axle assembly, 2 Wheel Drive and 4 Wheel Drive.

DIFFERENTIAL - Need, Construction.

UNIT – IV:

STEERING - Principle of steering, Steering Geometry and wheel alignment, steering linkages, Steering gearboxes, Power steering

SUSPENSION - front axle Suspension system, Independent and Solid axle. Coil, leaf spring and air suspensions, torsion bar, shock absorbers

BRAKING SYSTEM needs Classification, Drum and Disc, Mechanical, Hydraulic and pneumatic, vacuum assist Retarders, Anti-lock Braking System.

UNIT – V:

ELECTRICAL SYSTEMS- Battery, General electrical circuits, cut out relay, Dash board instrumentation, Passenger comfort.

ENGINE EMISSION CONTROL: Introduction, types of pollutants, methods of controlling, engine modification, exhaust gas treatment- Thermal and catalytic converters-use of alternative fuels for emission control – National and International pollution standards.

TEXT BOOKS:

1. Automotive Mechanics, Vol. 1 & Vol. 2, Kirpal Sing, standard publishers.

2. Automobile Engineering- P.S Gill, S.K. Kataria & Sons, New Delhi.

REFERENCE BOOKS:

1. David A. Corolla, (2009), Automotive Engineering: Powertrain, Chassis System and
2. Automotive Engines Theory and Servicing, James D. Haldermanand Chase D. Mitchell Jr., Pearson education inc.
3. Automobile Engineering, William Crouse, Tata McGraw Hill Distributors

WEB REFERENCES:

1. https://mechathon.com/components-parts-of-automobile/
2. https://www.wartsila.com/marine/build/engines-and-generating-sets/wartsila-engines-auxiliary-systems
3. https://www.britannica.com/technology/automobile/Transmission
4. https://www.qinetiq.com/en/what-we-do/services-and-products/vehicle-drive-technology
5. https://en.wikipedia.org/wiki/Automotive_safety

III B.TECH I SEMESTER Professional Elective-I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME3106	**REFRIGERATION AND AIR CONDITIONING**						

COURSE OBJECTIVES

The course content enables students to:

- Illustrate basic cycles of refrigeration and analyze the performance of the cycles
- Analyze the concepts of flow of refrigerant in different devices of VCR and VAR
- Design the air conditioning system for comfort requirements using different techniques

COURSE OUTCOMES

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

CO1: Illustrate of concepts of refrigeration and their applications.
CO2: Evaluate the performance parameters of different types of refrigeration systems.
CO3: Identify the desirable properties of refrigerant and its use in various refrigeration systems.
CO4: Examine the special types of refrigeration systems
CO5: Design of Air Conditioning systems for human comfort conditions.

UNIT-I

REFRIGERATION BASICS: Types of Refrigeration systems, and Applications**,**
REFRIGERANTS: Classification- Desirable properties- Nomenclature- Commonly used refrigerants- Alternate refrigerants –Greenhouse effect, global warming.
AIR REFRIGERATION SYSTEMS: Introduction-Air refrigeration system working on Reversed Carnot cycle-Air refrigeration system working on Bell Coleman cycle- COP- Open and Dense air systems, Applications. Air craft refrigeration systems.

UNIT – II

VAPOUR COMPRESSION REFRIGERATION SYSTEM: Working principle-Simple vapour compression refrigeration cycle-Representation of cycle on T-s and P-h charts- Effect of Sub cooling and Superheating-Actual Vapour compression cycle and its applications. Solve problems using P-h chart.
VCR SYSTEM COMPONENTS: Compressors-Classification-Working, Condensers, Classification - Working, Evaporators–Classification, Working, Expansion devices-Types-Working**.**

UNIT – III

VAPOUR ABSORPTION REFRIGERATION SYSTEM: Description and working of Aqua-Ammonia system- Calculation of maximum COP- Lithium Bromide- Water system-Principle of operation of three fluid absorption systems, Applications.
STEAM JET REFRIGERATION: Principle of working - Analysis - Applications.
NON-CONVENTIONALREFRIGERATION SYSTEMS: Thermo-electric Refrigeration, Vortex tube refrigeration.

UNIT – IV

PSYCHROMETRY: Introduction - Psychrometric properties and relations- Psychrometric chart Psychrometric processes-Sensible, Latent and Total heat–Sensible Heat Factor and Bypass Factor.
HUMAN COMFORT CONDITIONS: Thermodynamics of Human body-Effective temperature - Comfort chart. Industrial and central Air conditioning.

UNIT – V

AIR CONDITIONING SYSTEMS: Introduction-Components of Air conditioning system, Classification of Air conditioning systems-Central and Unitary systems- summer, winter and Year round systems- Cooling load estimation, Heat pump circuits, Air Handling Unit.

TEXT BOOKS:

1. Refrigeration and Air conditioning / CP Arora / Mc Graw Hill
2. Refrigeration and Air-Conditioning / RC Aora / PHI

REFERENCE BOOKS:

1. Principles of Refrigeration - Dossat / Pearson
2. Basic Refrigeration and Air-Conditioning / Ananthanarayanan / Mc Graw Hill

WEB REFERENCES:

1. https://home.howstuffworks.com/refrigerator4.htm
2. https://www.ashrae.org/
3. https://en.wikipedia.org/wiki/Air_conditioning

III B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-I	3	0	0	30	70	100	3
Code: R20ME3107	**METAL CUTTING AND MACHINE TOOLS**						

COURSE OBJECTIVES:

The course content enables students to

- Impart the fundamental aspects of the metal cutting principles and their applications by studying the behavior of various machining processes
- Train in knowing the fundamental parts of various machine tools
- Discuss the various principles of jigs and fixtures which will be used to hold the work pieces in various machine tools

COURSE OUTCOMES:

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

CO1: Identify different cutting tool materials, and tool nomenclature and calculate cutting parameters to enhance tool life

CO2: Explain the construction and specification of various machine tools and apply machining economics

CO3: Explain the working of Shaping, slotting, planning, drilling, and boring machines and apply machining economics

CO4: Illustrate the working of milling machines and apply machining economics.

CO5: Distinguish the working of grinding, lapping, honing, and broaching processes.

UNIT-I:

THEORY OF METAL CUTTING

Basic elements of machining, Machine shop Layout, orthogonal and oblique metal cutting Mechanics of orthogonal cutting; chip formation, Types of chips, Mechanics of chip formation, forces in machining shear angle and its significance, Merchant circle diagram. Numerical problems. Cutting tools – single point cutting tool nomenclature, cutting tool materials, tool wear, tool life, the effect of process parameters on tool life, problems on tool life, cutting fluids, and Machinability.

UNIT-II:

LATHE MACHINES

Centre lathe, constructional features, specification, operations – taper turning methods, thread cutting methods, special attachments, machining time, and power estimation. Capstan and turret lathes- tool layout – automatic lathes: semi-automatic – single spindle: Swiss-type, automatic screw type – multi-spindle

UNIT-III:

RECIPROCATING AND DRILLING MACHINES

Reciprocating machine tools: shaper, planer, slotter: Types and operations- Hole making: Drilling, reaming, boring, Counter Boring, Counter Shrinking, tapping. Types of drilling machines-Radial drilling Machines, portable and bench drilling machines.

UNIT-IV:

MILLING: classification of milling machines, Vertical and Horizontal milling machines, up milling down milling. Types of milling cutters, Various Milling operations, Gear Cutting.

INDEXING: need of indexing, simple, compound, and differential indexing**.**

JIGS&FIXTURES: Principles of jigs and fixtures, use the classification of jigs and fixtures.

UNIT-V:

FINISHING PROCESSES: Theory of grinding – classification of grinding machines, Cylindrical and surface grinding machines, tool and cutter grinding machines, different types of abrasives, bonds, specifications, and selection of a grinding wheel. Truing and dressing, Lapping, Honing, Broaching Processes.

TEXTBOOKS:

1. Manufacturing Technology II, P.N Rao, Tata Mcgraw hill publishers
2. Workshop Technology, B.S.RaghuVamshi–Vol II, DhanpatRai&Co

REFERENCE BOOKS:

1. Production Technology by H.M.T., Tata McGraw-Hill Education
2. Production Engineering, K.C Jain & A.K Chitaley, PHI Publishers
3. Production Technology, R.K. Jain and S.C. Gupta, Khanna Publisher

WEB REFERENCES:

1. http://nptel.ac.in/courses/112105127/pdf/LM-01.pdf
2. http://nptel.ac.in/courses/112105127/pdf/LM-02.pdf
3. http://nptel.ac.in/courses/112105127/pdf/LM-03.pdf
4. http://nptel.ac.in/courses/112105127/pdf/LM-04.pdf
5. http://nptel.ac.in/courses/112105127/pdf/LM-05.pdf
6. http://nptel.ac.in/courses/112105127/pdf/LM-06.pdf
7. http://nptel.ac.in/courses/112105127/pdf/LM-08.pdf
8. http://nptel.ac.in/courses/112105127/pdf/LM-14.pdf
9. http://nptel.ac.in/courses/112105127/pdf/LM-25.pdf
10. https://nptel.ac.in/courses/112/105/112105233/
11. http://home.iitk.ac.in/~vkjain/Lecture2-Metalcutting.pdf

III B.TECH I SEMESTER Professional Elective-I	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME3108	**WORK STUDY**						

COURSE OBJECTIVES

The course content enables students to:

- Think and explore the ways to make the job easy or have time be productive.
- Explain how to improve productivity through work study.

COURSE OUTCOMES

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

CO1: **Demonstrate** the fundamental concepts of work systems and work study**.**

CO2: **Demonstrate** the fundamental concepts of method study.

CO3: **Analyze** the movements at workplace.

CO4: **Explain** work measurement and time study.

CO5: **Explain** work sampling and predetermined time standards. Predetermined motion time measurement (MTM).

UNIT I:

Productivity: Definition of productivity, individual enterprises, task of management Productivity of materials, and, building, machine and power. Work Study: Definition, objective and scope of work study, advantages. Human factor in work study Work study and management, work study and supervision, work study and worker.

UNIT II:

Introduction to Method Study: Definition, objective and scope of method study, activity recording and exam aids. Charts to record moments in shop operation – process charts, flow process charts, travel chart and multiple activity charts.(With simple problems)

UNIT III:

Micro and Memo Motion Study: Charts to record moment at work place – principles of motion economy, classification of movements, two handed process chart, SIMO chart, and micro motion study. Development, definition and installation of the improved method.

UNIT IV:

Introduction to Work Measurement: Definition, objective and benefit of work measurement. Work measurement techniques. Work sampling: need, confidence levels, sample size determinations, with simple problems. Time Study: Time Study, Definition, time study equipment, selection of job, steps in time study. Breaking jobs into elements, recording information. Rating, Systems of rating.

UNIT V:

Scales of rating, factors affecting rate of working, allowances and standard time determination. Predetermined motion time study – Method time measurement (MTM) Wages and Incentives: introduction, definition, wage differentials, methods of wage payment, Advantages, disadvantages, financial incentives, non-financial incentives.

TEXT BOOKS:

1. ILO -Introduction to work study, ISBN 13:9788120406025 Publisher: India Book House Pvt. Ltd, 4th Revised Edition, 2008.
2. Ralph M Barnes -Motion and Time study, ISBN: 13:978981426182 Publisher: John Wiley, 7th edition 2009.

REFERENCES BOOKS:

1. M S Sanders and E J McCormic -Human Factors in Engineering Design, ISBN: 13:9780070549012, Mc Graw Hill, 7th Edition,1992.
2. R.S.Bridger -Introduction to Ergonomics, ISBN:13:9780849373060, Publisher Taylor and and Francis dated 20th Aug 2008, 3rdEdition

WEB LINKS:

1. http://fmcet.in/MECH/ME2027_uw.pdf
2. http://egyankosh.ac.in/bitstream/123456789/31709/1/Unit-6.pdf
3. http://egyankosh.ac.in/bitstream/123456789/31709/1/Unit-6.pdf

III B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME31L1	**ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING LAB**						

COURSE OBJECTIVES:

- To make the student to get a clear understanding of the core concepts of pre-processing techniques, classification and regression techniques using python.

COURSE OUTCOMES:

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

CO 1: Apply various pre-processing Techniques on the given data.
CO 2: Construct regression models for a given data.
CO 3: Build classification models for a given data.

LIST OF EXPERIMENTS

Open-source scripting language, Python IDLE, Anaconda

1. Apply Binarization data pre-processing technique on sample data.
2. Apply Mean Removal data pre-processing technique on sample data.
3. Apply Min and Max scaling on sample data.
4. Apply normalization data pre-processing technique on real estate data.
5. How to encode the labels and show the performance of encoded labels.
6. Using Pandas perform the following
   a. Handling.
   b. Slicing.
   c. Extracting statistics from Time Series Data.
7. Using python program build a Linear Regression.
8. Use the sklearn package Prepare a Classification model using decision tree Classifier.
9. Use the sklearn package Prepare a Classification model using Navie Bayes Classifier

III B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME31L2	**HEAT POWER ENGINEERING LAB**						

COURSE OBJECTIVES:

The course content enables students to:

- Perform different experiments on engines for determination of performance and emissions
- Estimate the fuel property calorific value using Junkers and bomb calorimeters
- Determination of dryness fraction of given steam sample using throttling calorimeter

COURSE OUTCOMES:

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

CO1: Demonstrate the various horse powers, Calorific values, emissions of IC engines.

CO2: Determine the various efficiencies and energy balance for several types of Internal Combustions Engines and compressors.

LIST OF EXPERIMENTS:

1. Determination of Calorific Value of gaseous Fuel by Junker's Calorimeter.
2. Performance Analysis of Heat Pipe.
3. Engine Performance with Turbo Charger.
4. Emission Studies of IC Engine using five gas analyzer.
5. Performance Analysis of Vapour Compression Test Rig.
6. Economical Speed Test on Four Stroke Multi-cylinder Petrol Engine.
7. Performance Test on Solar Flat Plate Collector Test Rig.
8. Retardation Test on Single Cylinder Diesel Engine.
9. Dryness fraction measurement by separating and throttling calorimeter.
10. Carbon Residue Test of Engine Oil.
11. Study of Boilers.

VIRTUAL LAB EXPERIMENTS:

1. Torque crank angle curve of SI Engine:
   http://vlabs.iitkgp.ernet.in/rtvlas/#
2. Determination of Cylinder MEP:
   http://vlabs.iitkgp.ernet.in/rtvlas/#
3. Torsional Vibrations of an Engine:
   http://vlabs.iitkgp.ernet.in/rtvlas/#

III B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	4	-	50	50	2
Code : R20ME31SC3	**ROBOTICS & 3D PRINTING LAB**						

COURSE OBJECTIVES:

The course content enables students to:

- The course in intended to provide knowledge of basic 3D printing elements, control and robotics.
- Candidates are trained on the 3D printing software (viz., Thinkercad and CURA) to gain the first-hand experience of 3D printing and manufacturing.

COURSE OUTCOMES:

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

CO1: Model and manufacture mechanical components using 3D printer.

CO2: Operate a robot efficiently.

LIST OF EXPERIMENTS:

This lab has been divided into two streams namely 3D printing lab and Robotics lab. Robotics lab has more exposure towards pick and place operations, and operating a robot effectively and analyse the kinematic mechanisms for position control systems. 3D printing lab will give an overall exposure towards modelling and printing of any structural elements.

3D PRINTING LAB

11. Experiments on Thinker Cad.
12. Pre-processing STL file using CURA software.
13. Manufacture Hexagonal Nut using 3D Printer.
14. Manufacture Connecting rod, Piston using 3D Printer.
15. Manufacture Kinematic Mechanism using 3D Printer
16. Simulation of Delta 3D Printing Machine – Virtual Lab

ROBOTICS LAB

1. Introduction to CProg software
2. Pick and place operation using Electromagnetic Gripper Robot.
3. Pick and place operation using Pneumatic Gripper Robot.
4. Pick and place operation by Electromagnetic Gripper Robot using Teach Pendent.
5. Collaborating Two Robots using PLC.

VIRTUAL LABS:

1. http://vlabs.iitkgp.ernet.in/mr/#

III B.TECH I-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	0	0	0	0	0
Code : R20CC31MC01	**PROFESSIONAL ETHICS AND HUMAN VALUES**						

LEARNING OBJECTIVES:

Unit I: Learn about morals, values & work ethics. Learn to respect others and develop civic virtue. Develop commitment and learn how to live peacefully.
Unit II: Learn about the different professional roles to be played by Engineer.
Unit III: Provide depth knowledge on Principles of Harmony and How emotional competencies helps them to accomplish goals, meet challenges, and engage effectively in social groups and environments.
Unit IV: Develop knowledge about Professional and Individual Rights. Create awareness on Collective Bargaining and Industrial Espionage.
Unit V: Create awareness about safety, risk & risk benefit analysis. Engineer's design practices for providing safety. Provide knowledge on intellectual property rights.

COURSE OUTCOMES: Student is able to

CO1: Interpret the fundamentals of Human values. [K2]
CO2: Analyse the ethical issues and role of engineers in industry. [K4]
CO3: Develop the principles of harmony in value education. [K3]
CO4: List out the duties and rights of engineers. [K4]
CO5: Summarise the engineer's responsibilities towards safety and risk. [K2]

Unit-I

Human Values: Ethics, Morals, Values, Integrity, Work Ethics- Service Learning – Civic Virtue- Respect for Others- Living Peacefully- Caring- Sharing- Honesty- Courage- Value Time- Cooperation- Commitment – Empathy- Self-Confidence- Spirituality- Character.

Unit-II

Engineering Ethics: Professional Roles to Be Played By Engineer- Engineers Role As Managers, Consultants And Leaders- Ethical Theories and Its Uses.

Unit- III

Principles for Harmony:

Truthfulness – Customs and Traditions -Value Education – Human Dignity – Human Rights – Fundamental Duties - Aspirations and Harmony (I, We & Nature) – Gender Bias – Emotional Intelligence – Salovey – Mayer Model – Emotional Competencies – Conscientiousness.

Unit-IV

Engineers' Duties and Rights: Concept of Duty - Professional Duties – Collegiality - Techniques for Achieving Collegiality –Senses of Loyalty - Consensus and Controversy - Professional and Individual Rights –Confidential and Proprietary Information - Conflict of Interest-Ethical egoism – Collective Bargaining – Confidentiality - Gifts and Bribes - Problem solving-Occupational Crimes-Industrial Espionage- Price Fixing-Whistle Blowing.

Unit-V

Engineers' Responsibilities towards Safety and Risk:
Concept of Safety - Safety and Risk – Types of Risks – Voluntary v/s Involuntary Risk – Consequences - Risk Assessment – Accountability – Liability - Reversible Effects – Threshold Levels of Risk - Delayed v/s Immediate Risk - Safety and the Engineer – Designing for Safety – Risk-Benefit Analysis-Accidents.

TEXT BOOKS

1. "Professional Ethics and Morals by Prof. A.R.Arasri, Dharanikota Suyodhana- Maruthi Publications.
2. Professional Ethics by R. Subramaniam – Oxford Publications, New Delhi.
3. Ethics in Engineering by Mike W. Martin and Roland Schinzinger - Tata McGraw-Hill – 2003.

REFERENCES:

1. Professional Ethics by R. Subramaniam – Oxford Publications, New Delhi.
2. Ethics in Engineering by Mike W. Martin and Roland Schinzinger - Tata McGraw-Hill –2003.
3. Engineering Ethics by Harris, Pritchard and Rabins, Cengage Learning, New Delhi.
4. Human Values & Professional Ethics by S. B. Gogate, Vikas Publishing House Pvt. Ltd., Noida.
5. Engineering Ethics & Human Values by M.Govindarajan, S.Natarajan and V.S.SenthilKumar-PHI Learning Pvt. Ltd – 2009.
6. Professional Ethics and Human Values by A. Alavudeen, R.Kalil Rahman and M. Jayakumaran – University Science Press.
7. Professional Ethics and Human Values by Prof.D.R.Kiran-Tata McGraw-Hill - 2013
8. Human Values and Professional Ethics by Jayshree Suresh and B. S. Raghavan, S.Chand Publications.

III B.TECH – II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Design of Machine Elements-II	R20ME3201	PC	30	70	100	2	1	0	3
2	Heat Transfer	R20ME3202	PC	30	70	100	2	1	0	3
3	Dynamics of Machinery	R20ME3203	PC	30	70	100	2	1	0	3
4	**Professional Elective Course -II**		PE	30	70	100	3	0	0	3
	Advanced Mechanics of Solids	R20ME3204								
	Nonconventional Sources of energy	R20ME3205								
	Quality concepts in Design`	R20ME3206								
	Robotics & Applications	R20ME3207								
5	**Open Elective Course/Job Oriented Elective - II**		OE	30	70	100	3	0	0	3
	Industrial Engineering & Management (Other than ME)	R20CC2OE05								
	Industrial Robotics (Other than ME)	R20CC2OE06								
6	Heat Transfer Lab	R20ME32L1	PC	15	35	50	0	0	3	1.5
7	Machine Tools and Machine Dynamics Lab	R20ME32L2	PC	15	35	50	0	0	3	1.5
8	Pneumatics & HVAC Lab	R20ME32L3	PC	15	35	50	0	0	3	1.5
9	English for Employability Skills	R20CC32SC1	SC	-	50	50	0	0	4	2
10	Essence of Indian Traditional Knowledge	R20CC32MC1	MC				2	0	0	0
									Total	**21.5**
11	Honors / Minors Courses	-	HC	30	70	100	4	0	0	4

III B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20ME3201	**DESIGN OF MACHINE ELEMENTS -2 (Design Data Book is allowed)**						

COURSE OUTCOMES:

CO1: **Apply** the design procedure to engineering problems, including the consideration of technical and manufacturing constrains of bearings.

CO2: **Identify** the loads and stresses while designing the connecting rod and crank shaft.

CO3: **Analyze** stresses on the piston and cylinder depending upon Design and proportions.

CO4: **Identify** the loads and machine members subjected and calculate static and dynamic stresses to ensure safe design.

CO5: **Compare** capacities of power transmission of Belt, Rope and Chain Drives.

UNIT – I:

DESIGN OF BEARINGS: Types of bearings, Lubrication, Bearing Modulus, Full and partial bearings, Clearance ratio, Heat dissipation of bearings, bearing materials, Journal bearing design, Ball and roller bearings, Static loading of ball & roller bearings, Bearing life.

UNIT – II:

DESIGN OF I.C ENGINE COMPONENTS: Connecting Rod, Thrust in connecting rod, Stress due to whipping action on connecting rod ends, Cranks and Crank shafts- strength and proportions of over hung and centre cranks, Crank pins.

UNIT – III: PISTONS AND CYLINDERS

Pistons, Forces acting on piston, Construction, Design and proportions of piston, Cylinder. Cylinder liners.

UNIT – IV:

DESIGN OF CURVED BEAMS: introduction, stresses in curved beams, Expression for radius of neutral axis for rectangular, circular, trapezoidal and T-Section, C – clamps. Design of crane hook.

UNIT – V:

POWER TRANSMISSION SYSTEMS: Transmission of power by Belt and Rope drives, Transmission Efficiencies, Belts – Flat and V types – Ropes - pulleys for belt and rope drives, Materials, Chain Drives, Tensions of Belt and Chain Drives.

TEXT BOOKS:

1. Machine Design, V.B. Bandari, Tata McGraw Hill Publishers.
2. Machine Design, Pandya & Shaw, Charotar publishers.

REFERENCES:

1. Machine Design, R.N. Norton, Pearson Publishers.
2. Design Data hand book. S.Md.Jalaludeen, Anuradha Publishers.
3. Mechanical Engineering Design, JE Shingly, Tata McGraw Hill Publishers.

WEB REFERENCES:

1. https://www.digimat.in/nptel/courses/video/112105124/L01.html
2. http://nptel.vtu.ac.in/econtent/courses/ME/06ME61/index.php
3. http://creativestellars.blogspot.com/p/design.html
4. https://www.jntumaterials.co.in/2015/04/jntujntuk-design-of-machine-members-i.html
5. https://lecturenotes.in/subject/549/design-of-machine-members-i

III B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20ME3202	**HEAT TRANSFER**						

COURSE OUTCOMES:

The student will be able to

CO1: Illustrate various modes of heat transfer
CO2: Analyze various methods of heat transfer using extended surfaces and fins
CO3: Estimate heat loss from the system to the surroundings using convection.
CO4: Determine various methods of design of heat exchangers.
CO5: Estimation of radiation heat transfer between bodies.

UNIT-I

INTRODUCTION: Basic Modes of heat transfer, Steady state Heat Conduction- General Conduction equation in Cartesian and Cylindrical coordinates, Initial and Boundary conditions.

ONE-DIMENSIONAL STEADY STATE HEAT CONDUCTION: Heat flow through plane wall and cylinder with constant thermal conductivity, Heat flow through composite slab and Cylinders, Thermal resistance, Electrical analogy, critical insulation thickness, uniform heat generation in slabs.

UNIT-II

FINS & EXTENDED SURFACES: Types, Applications, Fin materials, Heat transfer from fins with uniform cross section, Fin efficiency and Effectiveness.

ONE-DIMENSIONAL UNSTEADY STATE HEAT CONDUCTION: Analytical Solutions for Plane wall, cylinder and sphere, Lumped heat capacity systems, transient temperature charts.

UNIT-III

INTRODUCTION TO CONVECTION: Non Dimensional Analysis, Buckingham –π Theorem.

FORCED CONVECTION: External Flows: Introduction, Principles of convection. Hydrodynamic and thermal boundary layers and their thicknesses. Correlations for heat transfer in Laminar and Turbulent flows over a flat plate relation between fluid friction and heat transfer in laminar flows.

INTERNAL FLOWS: Division of Internal Flow through Concepts of Hydrodynamic and Thermal Entry Lengths-Use of Empirical Relations for Convective Heat Transfer in Horizontal Pipe Flow.

UNIT–IV

NATURAL CONVECTION: Mechanism of natural convection, Development of Hydrodynamic and thermal boundary layer along a vertical plate- Use of empirical relations for Vertical plates and pipes.

HEAT EXCHANGERS: Classification, types of heat exchangers, Recuperators and Applications, Flow arrangement, Temperature distribution, Overall heat transfer coefficient, Fouling factor, LMTD and NTU methods of Heat exchanger analysis, correction for LMTD for use with multi pass and cross flow Heat Exchangers, Effectiveness,.

UNIT-V

BOILING: Pool boiling–regimes-calculations on nucleate boiling, critical heat flux and film boiling.

CONDENSATION REGIMES: Film wise and drop wise condensation.

RADIATION HEAT TRANSFER: Emission characteristics and laws of black-body radiation – Irradiation – total and monochromatic quantities – laws of Planck, Wien, Kirchhoff, Lambert, Stefan

and Boltzmann– heat exchange between two black bodies -concepts of shape factor – Emissivity – heat exchange between grey bodies.

TEXT BOOKS:

1. Heat and Mass Transfer /Arora and Domkundwar/Dhanpatrai & sons
2. Fundamentals of Engineering Heat and Mass Transfer / R.C. Sachdeva / New Age International

REFERENCE BOOKS:

1. Heat and Mass Transfer /Cengel/McGraw Hill.
2. Heat and Mass Transfer /D.S.Kumar / S.K.Kataria & Sons

WEB REFERENCES:

1. https://www.sciencedirect.com/topics/engineering/conduction-heat-transfer
2. http://thermopedia.com/content/750/
3. https://www.sciencedirect.com/topics/engineering/heat-convection
4. https://www.intechopen.com/books/advances-in-heat-exchangers/use-of-heat-transfer-enhancement-techniques-in-the-design-of-heat-exchangers
5. https://www.engineeringtoolbox.com/radiation-heat-transfer-d_431.html

III B.TECH II-SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	0	30	70	100	3
Code: R20ME3203	**DYNAMICS OF MACHINERY**						

COURSE OBJECTIVES:

1. To understand the effect gyroscopic couple in motor cycles, aeroplanes and ships.
2. To analyze the forces in clutches, brakes and dynamometers involving friction.
3. To analyze the speed and stability of governors and fly wheels
4. To learn analytical and graphical methods for calculating balancing of rotary and reciprocating masses.

COURSE OUTCOMES:

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

CO1 **analyse** the effect of precession motion on the stability of motor cycles, aero planes and ships, under gyroscope

CO2 **compute** the frictional losses and transmission in clutches

CO3 **compute** the frictional losses and transmission in brakes and dynamometers.

CO4 **analyze** the stability of different types of governors under dynamic analysis and study the difference between governor and flywheel

CO5 **analyze** balancing of rotating and reciprocating masses for primary and secondary forces by analytical and graphical methods

UNIT – I:

GYROSCOPE AND GYROSCOPIC EFFECTS: Introduction, Precessional Angular Motion, Gyroscopic Couple, Effect of precession motion on the stability of moving vehicles such as, Aero plane and Naval ship, Four wheel vehicle moving in a curved path, Two wheel vehicle Taking a Turn.

UNIT – II:

FRICTION CLUTCHES: Friction clutches- Single disc or plate clutch, Multiple disc clutch, Cone clutch, Centrifugal clutch.

BRAKES: Types of Brakes, Single Block or Shoe Brake, Simple Band Brake, Differential Band Brake, Internal Expanding Brakes. General description and operation of

UNIT – III

GOVERNERS: Types of Governors, Terms used in governors, Watt governor, Porter governor, Proell governor, Hartnell governor, Hartung governor, Sensitiveness of governors,

Flywheels: Functions, Differences between flywheel and governor, turning moment diagrams, flywheel analysis for I-C Engines and presses.

UNIT- IV

BALANCING OF ROTATING MASSES: Static balancing, Dynamic balancing, Balancing of a single rotating mass by a single mass rotating in the same plane, Balancing of a single rotating mass by two masses rotating in different planes, Balancing of several masses rotating in the same plane by analytical and graphical methods, Balancing of several rotating in different planes.

UNIT- V

BALANCING OF RECIPROCATING MASSES: Unbalanced force**,** Primary and Secondary unbalanced forces of reciprocating masses, Partial Balancing of unbalanced Primary force in a reciprocating engine, Partial balancing of Locomotives, Variation of Tractive force, Swaying Couple, Hammer Blow, Balancing of V-engines.

TEXT BOOKS:

1. Theory of Machines, Thomas Bevan, Pearson education publications.
2. Theory of machines, SS Rattan, Tata McGraw Hill publications.

REFERENCES:

1. Theory of Machines, W.G.Green, Blackie publications.
2. Mechanism and Machine Theory / JS Rao and RV Dukkipati / New Age
3. Theory of Machines / Shigley / MGH2.
4. Theory of Machines, R.S. Khurmi & J.K.Gupta, S. Chand Publications

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/104/112104114//
2. https://nptel.ac.in/courses/112/104/112104121/

III B.TECH II SEMESTER Professional Elective-II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME3204	**ADVANCED MECHANICS OF SOLIDS**						

COURSE OBJECTIVES

The course content enables students to:

- Introduce the concept of theories of stress and strain.
- Familiarize with the concepts of stresses and strains in un symmetric bending and torsion using classical methods.

COURSE OUTCOMES

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

CO1 **Illustrate** the theories of stress strain relations for engineering applications.
CO2 **Analyze** bending stresses in beams subjected to unsymmetrical bending.
CO3 **Analyze** the radial stress in curved beams subjected to concentrated and uniform loads.
CO4 **Analyze** stresses induced cylindrical bending of thin rectangular plates by classical methods.
CO5 **Illustrate** the torsion of thin wall torsion members subjected to multiple connected cross sections.

UNIT-I:

THEORIES OF STRESS AND STRAIN: Definition of stress at a point, Stress notation, Three-Dimensional Stress System - Normal and Shearing Stresses, Equilibrium Equations. Principal Stresses -Principal Planes, Principal Strains, Generalized Hooke's Law.

THEORIES OF FAILURE: Graphical Representation for Plane Stress, Derivation of Equations for Failure Theories, Yield Criteria, Tresca's yield Criterion, Von-Mises-Hencky yield criterion.

UNIT-II:

UNSYMMETRICAL BENDING: Bending stresses in Beams subjected to nonsymmetrical bending; deflection of straight beams due to nonsymmetrical bending.

SHEAR CENTER: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical sections**.**

UNIT-III:

CURVED BEAM THEORY: Winkler Bach formula for circumferential stress –limitations – correction factors–radial stress in curved beams – closed ring subjected to concentrated and uniform loads-stresses in chain links.

AXI-SYMMETRIC SECTIONS: Rotating Discs- flat discs

UNIT IV:

BENDING OF THIN PLATES: Cylindrical Bending of Thin Rectangular Plates, Plate with Simply Supported Edges Carrying UDL, Uniformly Loaded Rectangular Plate with Clamped Edges, Symmetrical Bending of Circular Plates, Uniformly Loaded Circular Plate.

UNIT-V:

TORSION: Linear elastic solution, Prandtl elastic membrane (Soap-Film) analogy, narrow rectangular cross section, hollow thin wall torsion members, multiple connected cross sections. Hollow thin wall torsion members, Thin wall torsion members with restrained ends.

TEXT BOOKS:

1. "Advanced Mechanics of materials", Boresi & Sidebottom, Wiley International, 6th edition.
2. "Strength of materials", Sadhu singh, Khanna Publication, 1st edition.

REFERENCE BOOKS:

1. "Theory of elasticity", Timoschenko S.P. and Goodier J.N., McGraw- Hill Publishers, 3rd Edition.
2. "Advanced Mechanics of Solids", L.S Srinath, McGraw Hill Education (India) Pvt. Ltd.3rd edition.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/101/112101095/
2. https://cosmolearning.org/courses/advanced-strength-of-materials/
3. http://www.engineering108.com/Data/Engineering/Mechanical/SM/Strength_Of_Materials_parts_IandII-Timoshenko.pdf

III B.TECH II SEMESTER Professional Elective-II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME3205	**NON- CONVENTIONAL SOURCES OF ENERGY**						

COURSE OBJECTIVES:

The course content enables students to:

- Summarize different sources of energy and its availability.
- Analyze the requirements for wind energy and design of wind energy systems.
- Illustrate different sources of renewable energy and conversion into useful work output.

COURSE OUTCOMES:

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

CO1: Describe the environmental aspects of non-conventional energy resources.

CO2: Describe the use of solar energy and the various components used in the energy production with respect to applications.

CO3: Appreciate the need of Wind Energy, OTEC and the various components used in energy generation and know the classifications

CO4: Illustrate the concept of geothermal energy resources.

CO5: Acquire the knowledge of fuel cells and its applications.

UNIT- I

INTRODUCTION: Scale of Quantities, Energy Usage by Humans: Estimate the impact on atmosphere, conventional Sources of energy, Need of Non – Conventional Energy Resources, Non-Conventional Energy Resources – An Overview, Energy Consumption, Consequences of the Energy Consumption.

UNIT-II

SOLAR ENERGY: Environmental impact of solar power, The Solar Energy incident on Earth, Power Received from Sun to Earth. Electromagnetic Radiation, Instruments for measuring the solar radiation. Solar Flat Plate collectors. Solar Energy Applications: Solar water Heating, Active and Passive Heating systems, Solar Still and Solar ponds, Solar Energy storage Devices.

UNIT-III

WIND ENERGY: Overview, Types of Winds, Availability of Wind energy in India, Horizontal and Vertical axis Wind mills, Parts and Materials of Windmills, Performance characteristics, Betz Limit derivation and its implications, Efficiency of Windmills.

OCEAN THERMAL ENERGY CONVERSION: Principle of Ocean thermal Energy Conversion, Challenges of OTEC, Open Cycle Method; Closed Cycle Method.

UNIT – IV

GEOTHERMAL ENERGY: Structure of Earth - Geothermal Regions - Hot springs - Hot Rocks, Hot Aquifers - Analytical Methods to estimate Thermal Potential - Harnessing Techniques, Electricity Generation Systems from geothermal energy.

UNIT-V

FUEL CELLS: Introduction and Overview of Fuel cells, Principle and Working, Types of Fuel cells – Low and High Temperature Fuel cells, Advantages and Disadvantages, Different types of Fuel cell Applications, Fuel Processing for Fuel Cells, Hydrogen Fuel cell and electrochemical kinetics of fuel cell, economic and environmental analysis on usage of fuel cell.

TEXTBOOKS

1. Non-Convention Energy Resources B H Khan McGraw Hill Education (India) Pvt. Ltd. 3rd Edition
2. Solar energy Subhas P Sukhatme Tata McGraw Hill 2nd Edition, 1996.
3. Non-Conventional Energy Sources G.D Rai Khanna Publishers 2003.

REFERENCE BOOKS

1. Renewable Energy Sources and Conversion Technology N.K.Bansal, Manfred Kleeman& MechaelMeliss Tata McGraw Hill. 2004
2. Renewable Energy Technologies Ramesh R & Kumar K U Narosa Publishing House New Delhi
3. Conventional Energy Systems K M, Non Wheeler Publishing Co. Ltd., New Delhi 2003
4. Non-Conventional Energy Ashok V Desai Wiley Eastern Ltd, NewDelhi200.

WEB REFERENCES:

1. https://www.energy.gov/eere/solar/solar-radiation-basics
2. https://www.wasp.dk/about-us
3. https://www.toppr.com/guides/physics/sources-of-energy/non-conventional-sources-of energy/

III B.TECH II SEMESTER Professional Elective-II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME3206	**QUALITY CONCEPTS IN DESIGN**						

COURSE OBJECTIVE:

- To study about robust design, embodiment principles, various methods in design of experiments, reliability charts and histograms and six sigma techniques.
- It helps the design cum quality engineer to get familiarized with various concepts in design, quality and reliability principles in the design of an engineering product or a service.

COURSE OUTCOMES:

Upon successful Completion of the course, the student will be able to:

CO1: **Apply** the knowledge of Differential calculus to solve problems related to the field of structural and thermal engineering by approximate and numerical methods.

CO2: **Design** a new component or improve the existing components using FEA

CO3: **Solve** the problems in solid mechanics and heat transfer using FEM

CO4: **Identify, formulate**, and solve engineering problems

CO5: **Use** the techniques, skills, and modern engineering tools necessary for engineering practice.

UNIT I: DESIGN FOR QUALITY

Quality Function Deployment -House of Quality-Objectives and functions-Targets-Stakeholders-Measures and Matrices-Design of Experiments –design process-Identification of control factors, noise factors, and performance metrics - developing the experimental plan- experimental design –testing noise factors- Running the experiments –Conducting the analysis-Selecting and conforming factor-Set points-reflecting and repeating.

UNIT II: FAILURE MODE EFFECT ANALYSIS

Basic methods - Refining geometry and layout, general process of product embodiment- Embodiment checklist Advanced methods: systems modeling, mechanical embodiment principles-FMEA method-linking fault states to systems modeling.

UNIT III:
DESIGN OF EXPERIMENTS

Basic methods- Two factorial experiments-Extended method- reduced tests and fractional experiments, orthogonality, base design method, higher dimensional fractional factorial design Statistical analysis of experiments: Degree of freedom, correlation coefficient, standard error of the residual test, ANOVA-ratio test.

UNIT IV:
STATISTICAL CONSIDERATION AND RELIABILITY

Frequency distributions and Histograms- Run charts –stem and leaf plots- Pareto diagrams-Cause and Effect diagrams-Box plots- Probability distribution-Statistical Process control–Scatter diagrams – Multivariable charts – Matrix plots and 3-D plots.-Reliability-Survival and Failure-Series and parallel systems-Mean time between failure-Weibull distributions.

UNIT V: DESIGN FOR SIX SIGMA

Basis of Six Sigma –Project Selection For Six Sigma- Six Sigma Problem Solving- Six Sigma In Service And Small Organizations - Six Sigma And Lean Production –Lean Six Sigma And Services.

TEXT BOOKS

1. Fundamentals of Quality control and improvement 2nd edition, AMITAVA MITRA, Pearson Education Asia, 2002.
2. Product Design And Development, KARL T. ULRICH, STEVEN D. EPPINGER, TATA Mc GRAW-HILL- 3rd Edition, 2003.

REFERENCES

1. Product Design Techniques in Reverse Engineering and New Product Development, KEVIN OTTO & KRISTIN WOOD, Pearson Education (LPE), 2001.
2. The Management and control of Quality-6th edition-James R. Evens, William M Lindsay.

WEB RESOURCES

1. https://prezi.com/zwr6rih5k7tg/quality-concepts-in-design/?fallback=1
2. https://www.slideshare.net/kitmechanicalofficial/ed7103-qcdnotes

III B.TECH II SEMESTER Professional Elective-II	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME3207	**ROBOTICS AND APPLICATIONS**						

COURSE OBJECTIVES The course content enables students to:

- Introduce the concepts of Robotic system, its components and control related to robotics.
- Learn about analyzing robot kinematics.

COURSE OUTCOMES:

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

CO1: Distinguish between automation and robotics and identify various components of robot.
CO2: Select appropriate type of actuators and sensors for different applications.
CO3: Analyze kinematics of a robot
CO4: Analyze Dynamics of a robot
CO5: Illustrate present and future applications of robots

UNIT 1:

FUNDAMENTALS OF ROBOTICS: Introduction to Robotics**,** components of robot, Robot history, robotic controls and systems, classification, challenges and opportunities,

HOMOGENOUS COORDINATES AND TRANSFORM REPRESENTATIONS: Vector spaces, inner products, vector norms, orthogonality, linear transformations, matrix multiplication, matrix groups, Coordinate transformations, rigid transformations, rotation matrices

UNIT 2:

ACTUATORS AND SENSORS

ACTUATORS: Types, working principles, applications and advancements (hydraulic devices, Electric motors such as DC servomotors and stepper motors, Pneumatic devices).

SENSORS: Basic Elements, General Classification of Sensors, types and working, use of sensors in robotics.

UNIT 3:

ROBOT KINEMATICS: The fundamentals of kinematics, differential kinematics and statics-Kinematic chains, Forward kinematics, Inverse kinematics- analytical methods.

UNIT 4:

ROBOT DYNAMICS: Differential kinematics- Jacobian computation, singular configurations, Configuration space operation, Dynamics- Lagrange, Euler and Newton, Euler formations, Problems.

UNIT 5:

ROBOT APPLICATIONS: Material Transfer, Material handling, loading and unloading, Processing, spot and continuous arc welding & spray painting, Assembly and Inspection. Path planning in robotics. Future applications of robots.

TEXT BOOKS:

1. Industrial Robotics, Groover M P, Pearson Education.
2. Robotics and Control, Mittal R K & Nagrath I J, Tata McGraw Hill.

REFERENCES:

1. Robotics: Fundamental Concepts and Analysis, Ashitava Ghosal, Oxford Publications.
2. Robotic Systems: Applications, Control and Programming; Edited by Ashish Dutta, Intech Open.
3. Robotics, Fu K S, McGraw Hill. 4. Robotic Engineering, Richard D. Klafter, Prentice Hall.

WEB RESOURCES:

1. https://www.intechopen.com/books/robotic-systems-applications-control-andprogramming.
2. http://planning.cs.uiuc.edu/node659.html
3. https://www.edx.org/course/robot-mechanics-and-control-part-i
4. https://www.edx.org/course/robotics-foundation-ii-robot-control
5. https://nptel.ac.in/courses/112/105/112105249/
6. http://www.robotictutorials.com/ ◊ for tutorials
7. http://vlabs.iitkgp.ernet.in/rislab/
8. http://www.mind.ilstu.edu/teachers/labs/robot/
9. http://vlab.amrita.edu/?sub=3&brch=271&sim=1642&cnt=3525
10. https://www.virtualroboticstoolkit.com/
11. https://www.robotlab.com/blog/robotlab-is-offering-free-online-virtual-robotics-andcoding-courses-to-those-affected-by-covid-19

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME32L1	**HEAT TRANSFER LAB**						

COURSE OBJECTIVES

The course content enables students to:

- Illustrate different conduction and convection heat transfer modes and estimate the rates of heat transfer
- Analyze the heat transfer in different apparatus like heat exchangers, condensers
- Theorize the method of heat transfer in radiation and other phenomena

COURSE OUTCOMES

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

CO1: Evaluate the amount of heat exchange for plane, cylindrical & spherical geometries

CO2: Compare the performance of extended surfaces and heat exchangers.

LIST OF EXPERIMENTS: (Any 10 Experiments has to be performed)

1. Determination of overall heat transfer co-efficient of a composite slab.
2. Determination of heat transfer rate through a lagged pipe.
3. Determination of heat transfer rate through a concentric sphere.
4. Determination of thermal conductivity of a metal rod.
5. Determination of efficiency of a pin-fin.
6. Determination of heat transfer coefficient in forced convection.
7. Determination of heat transfer coefficient in natural convection.
8. Determination of effectiveness of parallel and counter flow heat exchangers.
9. Determination of emissivity of a given surface.
10. Determination of Stefan Boltzmann constant.
11. Determination of heat transfer rate in drop and film wise condensation.
12. Determination of critical heat flux.
13. Study of Two Phase Flow
14. Study of Heat Transfer by Radiation

Virtual Lab Experiments:

1. Black Body Radiation
   http://htv-au.vlabs.ac.in/
2. Thermo Couple Seebeck Effect
   http://htv-au.vlabs.ac.in/

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	-	-	3	15	35	50	1.5
Code: R20ME32L2	**MACHINE TOOLS AND MACHINE DYNAMICS LAB**						

COURSE OBJECTIVES

The course content enables students to:

- To learn the step turning, taper turning and thread cutting on lathe machines
- To the operation of shaping, planning, drilling, milling and surface grinding
- To study the behavior of machine elements experimentally when subjected to dynamic forces.
- Develop understanding of dynamic balancing, gyroscopic forces and moments.
- To supplement the principles learnt in kinematics and Dynamics of Machinery.

COURSE OUTCOMES

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

CO 1: Illustrate the working of lathe, shaper, and planner, drilling, milling and grinding machines.
CO 2: Analyze the forces acting on cutting tools for different machines
CO3: Analyze the static and dynamic analysis by balancing
CO4: Determine the natural frequency of vibration of the vibrating system

LIST OF EXPERIMENTS:

MACHINE TOOLS LAB: (Any 6 Experiments has to be performed)

1. Plain turning and step turning operation on Lathe.
2. Taper turning operation on the lathe.
3. Thread cutting and Knurling operation on Lathe.
4. Surface grinding
5. Preparation of hexagonal nut on milling machine
6. Cutting a slot on the shaper machine
7. Drilling operation
8. Slotting operation

MACHINE DYNAMICS LAB: (Any 6 Experiments has to be performed)

1. Determination of the magnitude of gyroscopic couple, angular velocity of precession.
2. Static balancing using steel balls.
3. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
4. Determination of steady state amplitude of forced vibratory system without Damping.
5. Determination of steady state amplitude of forced vibratory system with Damping
6. Determination of natural frequency of free longitudinal vibrations
7. To determine the moment of inertia of a flywheel
8. To study the profile of a cam analysis system and to draw the displacement diagram for the follower and the cam profile.

VIRTUAL LAB:

1. http://vlabs.iitb.ac.in/vlabsdev/labs/mit_bootcamp/machine_tools/labs/exp1/index.php
2. https://fab-coep.vlabs.ac.in/exp1/Theory.html
3. https://virtlabs.tech/metal-cutting/
4. **https://mdmv-nitk.vlabs.ac.in/#**

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	0	0	3	15	35	50	1.5
Code: R20ME32L3	**PNEUMATICS AND HVAC LAB**						

COURSE OBJECTIVES

The course content enables students to:

- A platform to the student's for understanding the basic concepts of pneumatic devices and circuits.
- Gain confidence in qualitative and quantitative approach to circuit and components

COURSE OUTCOMES

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

CO1: Identify various components of pneumatic systems.
CO2: Select pump and actuators for fluid operated systems.
CO3: Develop different pneumatic circuits for simple applications
CO4: Design the cooling load requirements of a given Area/Building

LIST OF EXPERIMENTS:

Pneumatics:

1. Study of Pneumatic Elements and Differences between Hydraulics & Pneumatics.
2. Study and Draw ISO symbols used in pneumatic system.
3. Study the performance of compressor, FRL unit advantages, special valves and accessories of pneumatics.
4. Operation of a Single Acting Cylinder
5. Operation of a Double Acting Cylinder
6. Impulse Pilot Operation of a Single Acting Cylinder
7. Impulse Pilot Operation of a Double Acting Cylinder
8. Operation of a Single Acting Cylinder – Controlled from Positions Using Shuttle Valve
9. Construct and actuate Pneumatic circuit for the given sequencing of operations.

HVAC:

1. Determination of COP of VCR system
2. Study of Summer and Winter Air Conditioning Systems
3. Design of Air Conditioning System for an Auditorium/Building

Virtual Labs:

https://pc-coep.vlabs.ac.in/

III B.TECH II SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	1	-	2	-	50	50	2
Code: R20CC32SC1	**ENGLISH FOR EMPLOYABILITY SKILLS (Common to All Branches)**						

COURSE OBJECTIVES:

- To train the students to use language effectively in professional situations like group discussions, public speaking, presentations and interviews.
- To make the students understand the importance of body language.
- To expose the students to SWOT Analysis.

COURSE OUTCOMES:

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

CO 1: Write effective Resume for employment..
CO 2: Make formal presentations using relevant technical style of communication and appropriate strategies for both academic and professional purpose.
CO 3: Participate in Group Discussions using analytical and problem solving skills.
CO 4: Face job interviews confidently and enhance employability.

UNIT– I

Personal Introduction & JAM
SWOT Analysis

UNIT–II

Resume and Video Portfolio
Non Verbal Communication
Professional Etiquette.

UNIT–III

Presentation Skills
Emotional Intelligence (How to face ambiguity, uncertainty and cobntingencies)

UNIT-IV

Group Discussion

UNIT-V

Interview skills- Mock Interviews

REFERENCE BOOKS:

1. Rajendra Pal, J S KorlahaHi, *Essentials of Business Communication,* Sultan Chand & Sons
2. Andrea J. Rutherford, *Basic Communication Skills for Technology,* Pearson Education Asia
3. V. Prasad, *Advanced Communication Skills,* Atma Ram Publications
4. Sanjay Kumar, Pushp Lata, *Communication Skills,* Oxford University Press
5. Meenakshi Raman, Sangeeta Sharma, *Fundamentals of Technical Communication,* Oxford University Press

IV B.TECH – I SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	**Professional Elective Course-III**		PE	30	70	100	3	0	0	3
	Digital Manufacturing	R20ME4102								
	Design for Manufacturing	R20ME4103								
	Power Plant Engineering	R20ME4104								
	Optimization Techniques	R20ME4105								
	Total Quality Management	R20ME4106								
2	**Professional Elective Course-IV**		PE	30	70	100	3	0	0	3
	Finite Element Method	R20ME4107								
	Experimental Stress Analysis	R20ME4108								
	Solar Energy Systems	R20ME4109								
	Bid Data Analytics	R20ME4110								
	Automation in Manufacturing	R20ME4111								
3	**Professional Elective Course-V**		PE	30	70	100	3	0	0	3
	Industrial Engineering & Management	R20ME4112								
	Mechanical Vibrations	R20ME4113								
	Waste Heat Recovery Systems	R20ME4114								
	Production Planning and Control	R20ME4115								
	Electric & Hybrid Vehicles	R20ME4116								
4	**Open Elective Course/Job Oriented Elective –III**		OE	30	70	100	2	0	2	3
	Automotive Vehicles	R20CC3OE05								
	Nano Technology	R20CC3OE06								
5	**Open Elective Course/Job Oriented Elective -IV**		OE	30	70	100	2	0	2	3
	Pneumatics & Hydraulic Automation	R20CC4OE05								
	Mechatronics	R20CC4OE06								
6	**Humanity & Social**		HSSE	30	70	100	3	0	0	3

	Service Elective									
	1. Business Management Concepts for Engineering	R20CC4101								
	2. Entrepreneurship & Innovation	R20CC4117								
7	Mechatronics & Simulation Lab	R20ME41SC4	SC	-	50	50	0	0	4	2
8	Internship/ Community Service Project	R20CC41IN	SI	-	50	50	0	0	0	1.5
9	MOOCS Course	R20CC41MC	MC				0	0	0	1.5
									Total	**23**
	Honors / Minors Course (MOOCS)	-	HC	30	70	100	4	0	0	4

IV B.TECH I SEMESTER Professional Elective-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME4102	**DIGITAL MANUFACTURING**						

COURSE OBJECTIVES

The course content enables students to:

- Identifying the global trends that are changing in the society, products, and the manufacturing process.
- Explore and know the concepts of Industry 4.0.
- Explore how smart manufacturing principles have had a real impact in varied applications of sports, technology and medicine.

COURSE OUTCOMES

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

CO1: Illustrate the concepts and learn the tenets of smart manufacturing.

CO2: Interpret agile manufacturing systems and smart manufacturing standards.

CO3: Analyze implemented automated manufacturing systems.

CO4: Compare different concepts for multi-machine systems.

CO5: Choose the opportunities, challenges brought about by Industry 4.0

UNIT I:

INTRODUCTION: Basics of Smart manufacturing and its difference from conventional/legacy manufacturing, Role of Industry 4.0, nine pillars of smart manufacturing (Industry 4.0). Smart Manufacturing Processes, manufacturing concerns with compliances, skill gap, energy monitoring, and standards,

UNIT II:

SMART FACTORIES AND PROCESS IMPLEMENTATION: Introduction of smart factories, challenges, smart-predictable manufacturing, Benefits of Smart Factory Implementation, Hardware and Software, Agile manufacturing systems. Industrial internet of things (IIoT)

UNIT III:

SMART COMMUNICATION SYSTEMS: Basics of Communication Technologies for smart manufacturing systems – Cyber Physical Systems, Big Data analytics and Cloud computing; Industrial Artificial Intelligence – Intelligent Analytics Services.

UNIT IV:

SMART MANUFACTURING ENABLED TECHNOLOGIES: Smart design and Modelling, Monitoring and Intelligent Control of Machining/Manufacturing and Logistics/Supply Chain Processes.

CNC MACHINING AND PART PROGRAMMING: Numerical Control (NC) machine tools, NC Tooling and Automatic Tool Changers – CNC types, CNC Part Programming - fundamentals, manual part programming methods, Computer Aided Part Programming.

UNIT V:

INDUSTRIAL ENGINEERS AND INTELLIGENT MACHINES: Sizing the Gaps, Man, Machines and Product Flow, The Global Manufacturing Business and the Measure of Productivity, People, Machines and the Workplace, Globalization, Improving Information Capture/Traceability, Improving Intelligent Decision Making under uncertainty Production.

TEXT BOOKS

1. Smart Manufacturing Innovation and Transformation: Interconnection and Intelligence by Zongwei Luo, IGI Global, 2014
2. Industry 4.0: The Industrial Internet of Things by A Gilchrist; Apress; 1st edition 2016.

REFERENCES

1. Smart Manufacturing by Shoukat Ali; LAP LAMBERT Academic Publishing, 2016.
2. Smart Manufacturing: Concepts and Methods by Masoud Soroush, Michael Baldea, Thomas F. Edgar, Elsevier, 2020.
3. CAD / CAM / CAE, E.Zimmers & M.Groover, Pearson Education

WEB RESOURCES

1. https://www.edx.org/course/industry-40-how-to-revolutionize-your-business
2. https://www.coursera.org/specializations/digital-manufacturing-design-technology
3. https://www.experfy.com/training/courses/smart-manufacturing-the-connected-factory
4. https://nptel.ac.in/courses/106/105/106105195/
5. https://enterpriseiotinsights.com/20170830/smart-factory/three-smart-factory-case-studies-tag23-tag99
   https://professional.mit.edu/course-catalog/smart-manufacturing-moving-static-dynamic-manufacturing-operations
6. https://books.google.co.in/books/about/CAD_CAM_Computer_Aided_Design_and_Manufa.html?id=18cy2E-o8gIC

IV B.TECH I SEMESTER Professional Elective-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME4103	**DESIGN FOR MANUFACTURING**						

COURSE OBJECTIVES:

1. Understand the design rules and considerations with reference to various manufacturing processes.
2. To discusses capabilities and limitations of each manufacturing process in relation to part design and cost.
3. To examine DFM principles including how the design affects manufacturing cost, lean manufacturing, six sigma, etc.

COURSE OUTCOMES:

Upon completion of the course, the student will be able to:

CO1: Design components for machining.

CO2: Simulate the casting design and choose the best casting process for a specific product.

CO3: Evaluate the effect of thermal stresses in weld joints.

CO4: Design components for sheet metal work by understanding in depth the sheet metal processes and their formation mechanisms.

CO5: Design plastic components for machining and joining and selecting a proper processes for different joining cases.

UNIT - I

INTRODUCTION: Design philosophy-steps in design process-general design rules for manufacturability-basic principles of designing for economical production - creativity in design.

UNIT - II

MACHINING PROCESSES: Overview of various machining processes-general design rules for machining-dimensional tolerance and surface roughness- Fits and Tolerances- Design for machining – ease –redesigning of components for machining ease with suitable examples. General design recommendations for machined parts.

UNIT - III

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.

UNIT - IV

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. Forging: Design factors for forging – closed die forging design – parting lines of dies – drop forging die design – general design recommendations.

UNIT – V

Extrusion & Sheet metal work: Design guide lines extruded sections- design principles for punching, blanking, bending, deep drawing-Keeler Goodman forging line diagram.

Plastics: Visco elastic and creep behavior in plastics-design guidelines for plastic components.

TEXT BOOKS:

1. Design for manufacture, John cobert, Adisson Wesley 1995
2. Design for Manufacture by Boothroyd
3. Design for manufacture, James Bralla

REFERENCE:

1. Design for manufacture, James Bralla
2. Processes and Design for Manufacturing,Third Edition

WEB LINKS:

1. https://www.routledge.com/Processes-and-Design-for-Manufacturing-Third-Edition/Wakil/p/book/9781138581081.
2. https://www.taylorfrancis.com/books/mono/10.1201/9780429506635/processes-design-manufacturing-sherif-el-wakil.

IV B.TECH I SEMESTER Professional Elective-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME4104	**POWER PLANT ENGINEERING**						

COURSE OBJECTIVES

The course content enables students to:

- Identify different types of energy sources and processing of the energy sources
- Summarize the different thermodynamic cycles to be used for power plants
- Differentiate the types of power produced in different plants like solar, petrol, diesel and nuclear plants

COURSE OUTCOMES

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

CO1: Explain the layout, construction and working of the components inside a thermal power plant.

CO2: Illustrate the components inside a Diesel, Gas and Combined cycle power plants.

CO3: Analyze the concepts and flows and processes of different power plants.

CO4: Enumerate the types of power production from renewable energy

CO5: Examine the economics of power plants

UNIT- I

COAL & GAS BASED THERMAL POWER PLANTS:

RANKINE CYCLE: Layout of modern coal power plant, Super Critical Boilers, FBC Boilers, Steam Turbines, Condensers, Steam & Heat rate, Subsystems of thermal power plants - Fuel and ash handling, Draught system, Feed water treatment.

UNIT- II

DIESEL, GAS TURBINE POWER PLANTS:

General layout of Diesel Power Plant, Advantages, Disadvantages and Applications. Fuel & Lubrication system of Diesel power plant. Supercharging System of Diesel power Plant, Exhaust System and Cooling System of Diesel Power plant. Efficiency of Diesel Power Plant & Heat Balance Sheet.

GAS TURBINE: Classification & Elements of Gas Turbine Power Plant, Regeneration, Reheating, Auxiliary Systems, Gas Turbine Efficiency, Operations and Maintenance Performance, Applications.

UNIT- III

NUCLEAR POWER PLANTS

Basics of Nuclear power, Layout and subsystems of Nuclear Power Plants, Working of Nuclear Reactors: Boiling Water Reactor (BWR), Pressurized Water Reactor (PWR), Canadian Deuterium-Uranium reactor (CANDU), Breeder, Gas Cooled and Liquid Metal Cooled Reactors. Safety measures for Nuclear Power plants. Site selection and Commissioning Procedure.

UNIT- IV

POWER FROM RENEWABLE ENERGY

Hydro Electric Power Plants - Classification, Typical Layout and associated components. Selection of site for Hydro Electric Power Plant, Essential features of Power plant, Power House and Turbine setting, Draft Tubes.

UNIT- V

POWER PLANT ECONOMICS, POLLUTION AND ITS CONTROL:

Factors effecting Power plant Design, Effect of Power Plant on Costs, Power tariff types, Load distribution parameters, load curve, site selection criteria, relative merits & demerits, Capital & Operating Cost of different power plants. Air & Water Pollution by Thermal Power plants, Environment Concerns and Diesel Power Plant, Nuclear Power Plant and the Environment, Method for Pollution Control.

TEXT BOOKS:

1. Power Plant Engineering- P.K.Nag, Third Edition, Tata McGraw – Hill Publishing Company Ltd., 2008.
2. Power Plant Engineering – P.C.Sharma / S.K.Kataria Pub

REFERENCE BOOKS

1. A course in Power Plant Engineering –Arora and Domkundwar, Dhanpatrai& Co.
2. An Introduction to Power Plant Technology / G.D. Rai.

WEB REFERENCES:

1. http://indianpowersector.com/home/power-station/thermal-power-plant/
2. https://dieselgasturbine.com/power-plants-of-the-world-3/
3. https://en.wikipedia.org/wiki/Nuclear_power_plant
4. https://www.nrdc.org/stories/renewable-energy-clean-facts
5. https://aip.scitation.org/doi/10.1063/1.3220701

IV B.TECH I SEMESTER Professional Elective-III	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	30	70	100	3
Code: R20ME4105	**OPTIMIZATION TECHNIQUES**						

COURSE OBJECTIVES: The course content enables students to:

- Impart knowledge on various categories of existing engineering problems and solutions to such problems through different optimization techniques and approaches.
- It helps the design engineer to get familiarized with various concepts in design optimization, and reliability principles in the design of an engineering product.
- Provide knowledge on geometric programming.

COURSE OUTCOMES:

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

CO1 Use the various techniques of optimization and provide an optimum solution to the problems involving the design of machine elements.
CO2 Discrete the type of problems and optimize as per the requirements.
CO3 Assess the search methods and provide local and/or global maxima or minima.
CO4 Analyze stresses and the deflection of curved flexural members like chain links and crane hooks.
CO5 Apply the knowledge of optimization in designing of various machine elements and systems.

UNIT I:

INTRODUCTION General Characteristics of mechanical elements - Adequate and Optimum design - Principles of optimization - Formulation of objective function - Design constraints – Classification of optimization problem.

UNIT II:

UNCONSTRAINED OPTIMIZATION Single variable and Multivariable optimization- Techniques of unconstrained minimization – Golden section, Pattern and Gradient search methods – Interpolation methods.

UNIT III:

CONSTRAINED OPTIMIZATION Optimization with equality and inequality constraints - Indirect methods using penalty functions – Lagrange multipliers - Geometric programming - Constrained, mixed inequality and unconstrained minimization – Genetic algorithms.

UNIT IV:

STATIC APPLICATIONS Structural applications – Design of simple truss members - Design applications – Design of simple axial, transverse loaded members for minimum cost, maximum weight – Design of shafts and torsionally loaded members – Design of springs.

UNIT V:

DYNAMIC APPLICATIONS Dynamic Applications – Optimum design of single, two degree of freedom systems, vibration absorbers. Application in Mechanisms – Optimum design of simple linkage mechanisms.

TEXT BOOKS

1. Optimal design – Jasbir Arora, Mc Graw Hill (International) Publishers

2. Optimization for Engineering Design – Kalyanmoy Deb, PHI Publishers

REFERENCES

1. Engineering Optimization – S.S.Rao, New Age Publishers
2. Johnson Ray, C., "Optimum design of mechanical elements", Wiley, John & Sons, 1990.
3. Goldberg, D.E., "Genetic algorithms in search, optimization and machine", Barnen, Addison-Wesley, New York, 1989

WEB REFERENCES:

1. http://nptel.ac.in/courses/105/108/105108127/
2. https://nptel.ac.in/courses/112/105/112105235/
3. https://nptel.ac.in/courses/111/105/111105039/
4. http://web.mit.edu/16.810/www/16.810_L8_Optimization.pdf
5. http://apmonitor.com/me575/index.php/Main/BookChapters
6. http://www.cs.cmu.edu/~suvrit/teach/aopt.html

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-III	3	0	0	30	70	100	3
Code: R20ME4106	**TOTAL QUALITY MANAGEMENT**						

COURSE OBJECTIVES

The course content enables students to:

- Understand the concept of Quality.
- Exposure to challenges in Quality Improvement Programs.
- Implement Quality Implementation Programs.

COURSE OUTCOMES

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

CO 1 Interpret Quality Management principles and process.
CO 2 Distinguish different TQM principles of Leadership, Motivation, Team work and supplier relationship
CO 3 Identify and Recommend appropriate type of TQM tools for various industries
CO 4 Choose various Quality charts, Quality functions and TPM concepts
CO 5 Select various quality management systems

UNIT-I:

INTRODUCTION

Quality – Need, Evolution and Definitions – Dimensions of product and service quality – Basic concepts and elements of TQM - Advantages – TQM Framework – Contributions of Deming, Juran and Crosby – Barriers to TQM – Customer focus – Customer orientation, Customer satisfaction, Customer complaints, Customer retention, Cost of quality (COQ).

UNIT-II:

TQM PRINCIPLES

Contributions of Deming, Juran and Crosby, Leadership – Quality Statements, Strategic quality planning, Quality Councils – Employee involvement – Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal – Continuous process improvement – PDCA cycle, Japanese 5S principles, Kaizen – Supplier partnership – Partnering, Supplier selection, Supplier Rating.

UNIT- III:

TQM TOOLS AND TECHNIQUES I

The seven traditional tools of quality – New management tools – Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT – Bench marking-Examples – Reason to bench mark, Bench marking process – FMEA – Stages, Types.

UNIT IV:

TQM TOOLS AND TECHNIQUES II

Control Charts – Process Capability – Quality Function Deployment (QFD) – Taguchi quality loss function – TPM – Concepts, improvement needs – Performance measures.

UNIT V:

QUALITY MANAGEMENT SYSTEM

Leadership – Quality Statements, Strategic quality planning, Quality Councils –BBQI Certifications, Need for ISO 9000 – ISO 9001-2008 - TS16949 quality System – Elements, Documentation, Quality

Auditing – QS 9000– ISO 14000 – ISO 14001 -Concepts, Requirements and Benefits – TQM Implementation in manufacturing and service sectors

TEXT BOOKS:

1. Dale H.Besterfiled, Carol B.Michna,Glen H. Besterfield,Mary B.Sacre,Hemant Urdhwareshe and Rashmi Urdhwareshe, ―Total Quality Management, Pearson Education Asia, Revised Third Edition, Indian Reprint, Sixth Impression, 2013.
2. Janakiraman. B and Gopal .R.K., "Total Quality Management – Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006

REFERENCES:

1. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
2. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006. ISO9001-2015 standards

Web Links:

1. http://rmkec.ac.in/tmp/mech/Contents/totalqualitymanagement.pdf
2. http://www.ddegjust.ac.in/2017/Uploads/11/POM-324.pdf

IV B.TECH I SEMESTER Professional Elective-IV	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME4107	**FINITE ELEMENT METHODS**						

COURSE OBJECTIVES

The course content enables students to:

- enable the mathematical principles essential for the Finite Element Method (FEM) applied tomechanics of solids and thermal analysis
- provide an overview on Finite Element Method, Material models, and Applications
- analyze the various structural elements analysis and selection of suitable elements for the problems being solved.

COURSE OUTCOMES

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

CO1: apply the knowledge of Differential calculus to solve problems related to structural Engineering **by** approximate methods.

CO2: apply finite element method to solve problems in one dimensional bar element problems

CO3: apply finite element method for trusses and beams

CO4: apply finite element method for 2-D CST element, numerical integration

CO5: evaluate the rate of heat transfer and temperature distribution in thin plates and fin the longitudinal and transverse vibrations by eigen values and eigen vectors

UNIT I:

FUNDAMENTAL CONCEPTS: Stress and equilibrium, Strain-displacement relations, stress-strain relations in three dimensional elasticity, Plane stress and Plane strain conditions, Discretization, Interpolation functions, Local and Global coordinates, Steps in Finite Element Method, Applications of Finite Element Method.

UNIT II:

ONE DIMENSIONAL BAR PROBLEMS: Concept of Potential Energy, shape functions, Element stiffness matrix, Variational method, Rayleigh-Ritz method, Weighted Residual method, Treatment of boundary conditions, One dimensional bar element problems.

UNIT III:

ANALYSIS OF TRUSSES: Truss element, element Stiffness matrices, simple problems on trusses

ANALYSIS OF BEAMS: Beam Element, Shape functions and Element stiffness matrix, load vector for Concentrated and Uniformly Distributed Load, simple problems on beams.

UNIT IV:

TWO DIMENSIONAL PROBLEMS: Finite element modelling of two dimensional Problems - Constant Strain Triangle element - Treatment of boundary conditions, 2-D four nodded isoparametric element, Numerical integration Gaussian quadrature approach.

UNIT V:

STEADY STATE HEAT TRANSFER AND DYNAMIC ANALYSIS: 1- D Thermal analysis of thin plane wall, Analysis of a fin. Free vibrations, longitudinal vibrations and Transverse vibrations, Formulation of finite element model, Mass matrices, Evaluation of Eigen values and Eigen vectors for a Stepped bar.

TEXT BOOKS

1. Introduction to Finite Elements in Engineering, Chandraputla, Ashok and Belegundu, Prentice – Hall.
2. The Finite Element Method in Engineering by S.S.Rao, Elsevier.

REFERENCES

1. Finite Element Procedures by Bathe, K. J. 2nd ed. Klaus-Jürgen Bathe, 2014.
2. Textbook of Finite Element Analysis by P Seshu; PHI publisher.

WEB RESOURCES:

1. http://nptel.ac.in/courses/112/105/112105197
2. https://freevideolectures.com/course/2684/mechanical-vibrations
3. http://www.feaprofessor.com/tutorials.html
4. https://wiki.scilab.org/Finite%20Elements%20in%20Scilab
5. http://ocw2.mit.edu/resources/res-2-002-finite-element-procedures-for-solids-and-structures-spring-2010/linear/
   https://www.edx.org/course/a-hands-on-introduction-to-engineering-simulations

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-IV	2	1	-	30	70	100	3
Code: R20ME4108	**EXPERIMENTAL STRESS ANALYSIS**						

COURSE OBJECTIVES:

- To understand the relation between the mechanics theory and experimental stress analysis.
- To highlight the new experimental methods to determine stresses and strains.

COURSE OUTCOMES:

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

CO 1: **Illustrate** the three-dimensional stress strain relations for engineering applications.

CO 2: **Experiment with** recording instruments at different levels of frequencies for static and dynamic recording and birefringent coatings

CO 3: **Examine** the brittle coating stresses by brittle coating analysis and moiré-fringe analysis.

CO 4: **Illustrate** the Photo elasticity materials and isochromatic fringes for engineering applications.

CO 5: **Analyze the** three dimensional Photo elasticity models by Frozen-stress method, the scattered-light method

UNIT-I:

INTRODUCTION: Theory of Elasticity, Plane stress and plane strain conditions, compatibility conditions, problem using plane stress and plane strain conditions, three-dimensional stress strain relations.

STRAIN MEASUREMENT METHODS: various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauge circuits.

UNIT-II:

RECORDING INSTRUMENTS: Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies.

BIREFRINGENT COATINGS: Introduction, coating stresses and strains, coating sensitivity, coating materials, application of coatings, effects of coating thickness, fringe order determinations in coatings.

UNIT-III:

BRITTLE COATINGS: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

MOIRE METHODS: Introduction, mechanism of formation of Moire fringes, the geometrical approach to moiré-fringe analysis, the displacement field approach to Moire-fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of moiré-fringes, experimental procedure and techniques.

UNIT-IV:

PHOTO ELASTICITY: Photo elasticity, polariscope, plane and circularly polarized light, bright and dark filed setup, photo elasticity materials,, Isochromatic fringes – Isoclinics.

UNIT-V:

THREE DIMENSIONAL PHOTO ELASTICITY: Introduction, locking in model deformation, materials for three dimensional photo elasticity, machining cementing and slicing three dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the

shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method

TEXT BOOKS:

1. Timoshenke and GoodierJr ,"Theory of Elasticity" McGraw Hill Education (India) Pvt Ltd, 3e
2. Dally and Riley," Experimental stress analysis", McGraw-Hil

REFERENCE BOOKS:

1. Love .A.H, "A treatise on Mathematical theory of Elasticity vol-1" nabu press,
2. A treatise on Mathematical theory of elasticity / LOVE A.H./ Dover Publications
3. Photo Elasticity / Frocht/ Wiley / 3rd Edition
4. Experimental Stress Analysis / Sadhu singh / Khanna Publications.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/106/112106068/
2. https://www.springer.com/gp/book/9783319060859

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-IV	3	0	0	30	70	100	3
Code: R20ME4109	**SOLAR ENERGY SYSTEMS**						

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

CO1: Understand the potential and importance of non-conventional energy sources, concept of solar radiation and Energy conversion.

CO2: Understand the concept of solar radiation and Flat plate collectors.

CO3: Understand the concept of solar radiation and concentric tube collectors.

CO4: Understand PV technology principles and techniques of various solar cells / materials for energy conversion.

CO5: Understand the concepts of solar energy storage and Industrial applications

UNIT-I

SOLAR RADIATION: Source of radiation – Sun earth relationship- extraterrestrial radiation.– Atmospheric attenuation – Terrestrial radiation-radiation on a horizontal surfaces and inclined planes - relations between monthly, daily and hourly radiation and components of the radiations– solar charts – Critical radiation-Measurement of global, direct and diffuse solar radiation - pyroheliometer, pyranometer, pyrogeometer, sunshine recorder – solar radiation data assessment.

UNIT-II

SOLAR FLAT PLATE COLLECTORS: Design considerations – classification- Flat plate collectors- air heating collectors liquid heating –Temperature distributions- Heat removal rate- Useful energy gain - Losses in the collectors- efficiency of flat plate collectors – selective surfaces.

UNIT-III

SOLAR CONCENTRIC TUBE COLLECTORS: Tubular solar energy collectors- analysis of concentric tube collector – Comparison with flat plate collectors. Concentric collectors - Limits to concentration

– Concentrator mounting – tracking mechanism - performance analysis focusing solar concentrators: Heliostats.

UNIT-IV

PHOTOVOLTAIC SYSTEMS: Conversion of Solar energy into Electricity - Photovoltaic Effect, Photovoltaic material - Solar Cell – Module – Silicon solar cell, Efficiency limits, Variation of efficiency with band-gap and temperature, Efficiency measurements, High efficiency cells, Recent developments in Solar Cells, PV systems.

UNIT-V

ENERGY STORAGE: Sensible Heat Storage – Liquid media storage – Solid media storage – Latent heat storage - Phase change materials – Chemical storage

Industrial Applications of Solar Heating: Solar Thermal Power Plant, Solar Desalination, Solar Water Heating, Solar Air Heating, Solar Drying, Solar Cooking, Solar Greenhouse technology.

TEXT BOOKS:

1. Solar Cells and Their Applications, L D. Partain, L M. Fraas, John Wiley and Sons, 2010
2. Solar Energy Engineering, Soteris Kalogirou, Academic Press, 2009

REFERENCE BOOKS:

1. Solar Energy, Sukhatme S P, Tata McGraw-Hill Education, 2008
2. Handbook of Photovoltaic Science and Engineering, A Luque, S Hegedus, John Wiley and Sons, 2003
3. Solar Energy Fundamentals, Design, Modeling and Applications, G. N. Tiwari, Narosa Publishing House Pvt. Ltd., 2002
4. Solar Energy- Fundamentals & Applications, H.P. Garg and J. Prakash, Tata McGraw-Hill,2000.

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-IV	3	0	0	30	70	100	3
Code: R20ME4110	**BIG DATA ANALYTICS**						

COURSE OBJECTIVES:

- Introducing Java concepts required for developing map reduce programs.
- Optimize business decisions and create competitive advantage with Big Data analytics.
- Derive business benefit from unstructured data.
- Imparting the architectural concepts of Hadoop and introducing map reduce paradigm.
- To introduce programming tools PIG & HIVE in Hadoop echo system.

COURSE OUTCOMES:

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

CO 1: Interpret the architectural elements of big data and Hadoop framework.

CO 2: Analyse various big data applications using map reduce programming module.

CO 3: Analyse Spark capabilities such as distributed datasets, in-memory caching, and the interactive shell.

CO 4: Summarize Spark's powerful built-in libraries, including Spark SQL, Spark Streaming.

CO 5: Analyze Hadoop data with PIG and Hive. Interpret the applications and architecture of Mobile Computing and multiplexing techniques.

UNIT– I

STARTING HADOOP: -Google File System, -The building blocks of Hadoop: Name node, Data node, Secondary Name node, Job Tracker, Task Tracker. -Setting up SSH for a Hadoop cluster: Define a common account, Verify SSH installation, Generate SSH key pair, Distribute public key and validate logins. - Running Hadoop: Local (standalone) mode, Pseudo-distributed mode, fully distributed mode.

UNIT–II

Map Reduce: -A Weather Dataset: Data Format, -Analysing the Data with Hadoop: Map and Reduce, Java Map Reduce: A test run, the old and the new Java Map Reduce APIs.

Basic programs of Hadoop Map Reduce: Driver code, Mapper code, Reducer code, Record Reader, Combiner, Partitioner.

UNIT–III

Programming with RDDs: What Is Apache Spark, RDD Basics, Creating RDDs, RDD Operations, Passing Functions to Spark, Common Transformations and Actions, Persistence (Caching).

UNIT-IV

Pig: Hadoop Programming Made Easier: -Admiring the Pig Architecture, -Going with the Pig Latin Application Flow, -Working through the ABCs of Pig Latin: Uncovering Pig Latin structures, looking at Pig data types and syntax. -Evaluating Local and Distributed Modes of Running Pig Scripts, -Checking out the Pig Script Interfaces, -Scripting with Pig Latin

UNIT-V

Applying Structure to Hadoop Data with Hive: -Saying Hello to Hive, -Seeing How the Hive is Put Together, -Getting Started with Apache Hive, -Examining the Hive Clients: The Hive CLI client, The web browser as Hive client, SQuirreL as Hive client with the JDBC Driver. -Working with Hive Data

Types, -Creating and Managing Databases and Tables: Managing Hive databases, Creating and managing tables with Hive. -Seeing How the Hive Data Manipulation Language Works: LOAD DATA examples, INSERT examples, Create Table As Select (CTAS) examples. Querying and Analysing Data: Joining tables with Hive, Improving your Hive queries with indexes, Windowing in HiveQL, Other key HiveQL features.

TEXT BOOKS:

1. Tom White, "Hadoop: The Definitive Guide" 3rd Edition, O'Reilly Media.
2. Matei Zaharia, Holden Karau, Andi Konwinski, Patric Wendell, Learning Spark, O'Reilly Media,2015.
3. by Chuck Lam, "Hadoop in Action" MANNING Publ.
4. Dirk deRoos, Paul C.Zikopoulos, Roman B.Melnyk,Bruce Brown, Rafael Coss, "Hadoop for Dummies"

REFERENCE BOOKS:

1. Alex Holmes, "Hadoop in Practice", MANNING Publ.
2. Srinath Perera, "Hadoop MapReduce Cookbook", Thilina Gunarathne

WEB REFERENCES:

1. https://www.edx.org/learn/big-data
2. https://www.edureka.co/big-data-and-hadoop

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
Professional Elective-IV	3	0	0	30	70	100	3
Code: R20ME4111	**AUTOMATION IN MANUFACTURING**						

COURSE OBJECTIVES:

The course content enables students 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.

COURSE OUTCOMES:

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

CO 1. Illustrate the basic concepts of automation in machine tools.

CO 2. Analyze various automated flow lines, Explain assembly systems and line balancing methods.

CO 3. Describe the importance of automated material handling and storage systems.

CO 4. Interpret the importance of adaptive control systems and varies parameters.

CO 5. Describe the importance of automated inspection systems. And machine vision

UNIT-I:

INTRODUCTION:

Types and strategies of automation, pneumatic and hydraulic, Components, circuits, automation in machine tools, mechanical feeding and tool, changing and machine tool control.

AUTOMATED FLOW LINES: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations.

UNIT – II:

ANALYSIS OF AUTOMATED FLOW LINES:

General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

ASSEMBLY SYSTEM AND LINE BALANCING: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT – III:

AUTOMATED MATERIAL HANDLING AND STORAGE SYSTEMS:

Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT – IV:

ADAPTIVE CONTROL SYSTEMS:

Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations. Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

UNIT – V:

AUTOMATED INSPECTION:

Fundamentals, types of inspection methods and equipment, Coordinate Measuring Machines, Machine Vision- Introduction, image acquisition, and image processing applications of machine vision.

TEXT BOOK:

1. Automation, Production Systems and Computer Integrated Manufacturing: M.P. Groover./ PE/PHI.
2. Computer Control of Manufacturing Systems by Yoram Coren.

REFERENCE BOOKS:

1. CAD / CAM/ CIM / Radhakrishnan / New Age
2. Advanced Manufacturing Technology/ K Vara Prasada Rao / Kanna Publications

WEB REFERENCES:

1. https://www.youtube.com/watch?v=v-3TmN4HhLc
2. https://www.automationmag.com/4721-ebook

IV B.TECH I SEMESTER Professional Elective-V	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME4112	**INDUSTRIAL ENGINEERING & MANAGEMENT**						

COURSE OBJECTIVES

The course content enables students to:

- Understand various aspects related with industrial engineering and its relevance in the industrial environment.
- Inculcate the organizational structure, plant location and plant layout, production planning and control, scheduling, forecasting, statistical quality control.
- Equip the student with the basic management concepts and functions and to provide knowledge relating to recruitment, selection, training, and motivation of employees in the organization

COURSE OUTCOMES

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

CO1 Differentiate industrial engineering and industrial engineer, Taylor's and Fayol's principles
CO2 Design a system of organizational structures to achieve desired needs.
CO3 Understand the techniques, skills on how to provide wages and incentives for the labourers
CO4 Evaluate the concept of resource management and job evaluation techniques and benefits.
CO5 Apply concepts of operations management for design of industry layout

UNIT – I:INTRODUCTION:

Definition of industrial engineering (I.E), development, role of an industrial engineer, differences between production management and industrial engineering, concepts of management, importance, functions of management, Taylor's principles, theory X and theory Y, Fayol's principles of management, bath tub curve.

UNIT II: ORGANIZATIONAL STRUCTURES:

Departmentalization and Decentralization, Types of Organization structures - Line organization, Line and staff organization, Functional organization, Committee organization, Matrix organization, Virtual Organization, Cellular Organization, Team structure, Boundary less organization, Inverted pyramid structure, Lean and flat organization structure and their merits, demerits and suitability, Industrial relations.

UNIT – III: WAGE & INCENTIVE SYSTEMS:

Wages – definition, types – wage differentials – reasons, methods of wage payments, types of incentives, standard wage plans – Halsey, Weir, Emerson's, Rowans Gantt's task and Bonus systems, - Taylor's piece rate systems, Merric's piece rate system – Numerical problems on the above plans, incentives to the supervisor and executives, Labor Act.\

UNIT – IV: RESOURCE MANAGEMENT:

Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job-evaluation, its importance and types, merit rating, advantaged and disadvantages of merit rating.

UNIT – V: OPERATIONS MANAGEMENT:

Product design process- Process selection-Types of production system(Job, batch and Mass Production),Plant location-factors, Urban & Rural sites comparison, Types of Plant Layouts-Design of product layout, Line balancing (RPW method), Value analysis-Definition-types of values- Objectives, Phases of value analysis.

TEXT BOOKS:

1. Industrial Engineering and management by O.P Khanna, Khanna Publishers.
2. Industrial Engineering and Production Management, Martand Telsang, S.Chand& Company Ltd. New Delhi.
3. Statistical Quality Control by Gupta.

REFERENCE BOOKS:

1. Industrial Management by Bhattacharya DK, Vikas publishers.
2. Operations Management by J.G Monks, McGrawHill Publishers.
3. Industrial Engineering by Banga& Sharma.
4. Principles of Management by Koontz O' Donnel, McGraw Hill Publishers.
5. Industrial Engineering and Management by Raju, Cengage Publishers.

WEB LINKS:

- https://nptel.ac.in/courses/112/107/112107292/
- https://nptel.ac.in/courses/112/107/112107142/
- https://core.ac.uk/download/pdf/55638606.pdf
- https://civildatas.com/download/industrial-engineering-and-management-by-khanna

IV B.TECH I SEMESTER Professional Elective-V	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME4113	**MECHANICAL VIBRATIONS**						

COURSE OBJECTIVES

The course content enables students to:

- Understand Formulate mathematical models of problems in vibrations using Newton's second law or energy principles.
- Determine a complete solution to the modeled mechanical vibration problems.
- Correlate results from the mathematical model to physical characteristics of the actual system.
- Design of a mechanical system using fundamental principles developed in the class.

COURSE OUTCOMES

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

CO 1: Illustrate the natural frequency of free longitudinal vibrations of systems by using energy principles.

CO 2: Determine Natural frequency of free transverse vibrations over a shaft under Point loads, uniform distributed load and several loads.

CO 3: Analyze the damped vibrations and forced vibrations to the modelled mechanical vibration problems.

CO 4: Analyze free and forced vibration analysis of a two degree of freedom system under the formulation of equations of motion.

CO 5: Determine natural frequency of free torsional vibrations of one, two and three rotor systems by using energy principles.

UNIT-I:

FUNDAMENTALS OF MECHANICAL VIBRATIONS: Introduction**,** Basic Terminology used in Vibratory Motion, Degrees of freedom, Types of vibrations, Natural frequency of free longitudinal vibrations of systems having single degree of freedom – Equilibrium method, Energy method, Rayleigh's method.

UNIT – II:

TRANSVERSE VIBRATIONS: Natural frequency of free transverse vibrations – Cantilever Shaft due to point load at free end - Simply supported shaft due to a point load, Uniform distributed load - Fixed shaft at both ends due to Uniform distributed load. Natural frequency of free transverse vibrations over a shaft subjected to a number of point loads – Rayleigh's Method, Dunkerley's Method.

UNIT-III:

DAMPED VIBRATIONS: Critical or Whirling speed of a shaft, viscous damping- Over damping, under damping, critical Damping. Critical damping coefficient, damping factor, Logarithmic decrement.

FORCED VIBRATIONS: Frequency of under damped forced vibrations – Differential equation method. Magnification factor, Vibration isolation, Transmissibility.

UNIT-IV

TWO DEGREE OF FREEDOM SYSTEM: Free and forced vibration analysis of a two degree of freedom system – different methods for the formulation of equations of motion, natural frequencies, principal modes - physical interpretation and orthogonality; general method, Eigen value method

UNIT-V

TORSIONAL VIBRATIONS: Equivalent stiffness of spring combinations, Natural Frequency of free torsional vibrations, Effect of inertia of constraint, Torsional vibration of one, two and three rotor systems, Torsionally Equivalent shaft, torsional vibrations of a geared system; coordinate coupling – static and dynamic coupling.

TEXT BOOKS:

1. G.K. Grover & Nigam, "Mechanical Vibrations", Nem Chand and Brothers, 8th edition
2. Theory of machines, SS Rattan, Tata McGraw Hill publications.

REFERENCE BOOKS:

1. Thomson, "Theory of Vibration with Application", pearson India, 5th edition.
2. S.S. Rao, "Mechanical vibration", pearson India, 4th edition.
3. V.P.Singh,"Mechanical vibration" DhanpatRai& Co.
4. Schaum Series," Mechanical vibration" McGraw-Hill, 1st edition.
5. F.S. Tse, Morse &Hinkle,"Mechanical Vibration", CBS Publisher, 2nd edition.

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/103/112103111/
2. https://nptel.ac.in/courses/112/103/112103112/#
3. http://ndl.iitkgp.ac.in/document/g_kDps3B9vQMV2-zacLwxKF4JxxfRzInbpuP0Kj_yXn-Y1tJl_y_j6U6A0-B_tE
4. https://www.springer.com/gp/book/9783030450731
5. http://160592857366.free.fr/joe/ebooks/Mechanical%20Engineering%20Books%20Collection/VIBRATIONS/mechVib%20theory%20and%20applications.pdf

IV B.TECH I SEMESTER Professional Elective-V	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME4114	**WASTE HEAT RECOVERY SYSTEMS**						

COURSE OBJECTIVES

The course content enables students to:

- Estimate the possible waste heat sources and the methods of extraction of heat from the sources
- Illustrate the methodologies used for extraction of waste heat and physical requirements of extraction

COURSE OUTCOMES

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

CO1: Analyze the waste heat recovery technologies developed for various thermal systems.
CO2: Acquire knowledge on waste heat recovery in heat pump, thermoelectric and HVAC systems.
CO3: Apply the economic analysis concepts for the effective implementation of waste heat recovery.
CO4: Examine the concepts of low grade heat utilization
CO5: Identify the need for various energy storage systems in waste heat recovery applications.

UNIT I

INTRODUCTION:

Introduction to Waste heat, Importance of waste heat Recovery, Rankine cycle, Coupled cycles and combined plants energy resources and use, potential for energy conservation, optional utilization of fossil fuels, total energy approach.

UNIT II

WASTE HEAT RECOVERY SYSTEMS SELECTION CRITERIA: Recuperators -regenerators-economizers-plate heat exchangers-thermal fluid heaters.
WASTE HEAT BOILERS: classification, location, service conditions, design considerations.
OTHER HEAT EXTRACTION SYSTEMS: fluidized bed heat exchangers-heat pipe exchangers-heat pumps-absorption systems.

UNIT III

LOW GRADE HEAT UTILIZATION: Rejection of heat from power plants, Utilization of waste heat in refrigeration, heating, ventilation and air conditioning systems.

UNIT IV

ENERGY STORAGE: Need for energy storage, Thermal, electrical, magnetic and chemical storage systems. Advances in Energy Storage-Applications.

UNIT V

ECONOMIC ANALYSIS: Investment cost-economic concepts-measures of economic performance-procedure for economic analysis-examples-procedure for optimized system selection and design- load curves – sensitivity analysis -regulatory and financial frame work for cogeneration and waste heat recovery system.

TEXT BOOKS:

1. Principles of Waste Heat Recovery; Robert Goldstick, Albert Thumann; Fairmont Press, 1986
2. Heat Recovery Systems: A Directory of Equipment and Techniques; David Anthony Reay; E. & F. N. Spon, 1979

REFERENCE BOOKS:

1. Parker, Colin & Roberts, Energy from Waste-An Evalution of Conversion Technologies Elsevier Applied science.

2. Shah, Kanti L., Basics of Solid & Hazardous Waste Management Technology, Prentice Hall of India.

WEB REFERNCES

1. https://glomeep.imo.org/technology/waste-heat-recovery-systems/

IV B.TECH I SEMESTER Professional Elective-V	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME4115	**PRODUCTION PLANNING AND CONTROL**						

COURSE OBJECTIVES:

The course content enables students to:

- Understand the various components and functions of production planning and control such as work study, product planning, process planning, production scheduling, Inventory Control.

COURSE OUTCOMES:

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

CO1 Apply the systems concept for the design of production and service systems.

CO2 Make use of forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques.

CO3 Understand the principles and techniques of inventory management

CO4 Choose routing procedure and able to prepare bill of material.

CO5 Understand the importance and function of scheduling &Identify dispatching procedure and make use of computer in production planning and control

UNIT-I

INTRODUCTION: Definition, objectives and functions of production planning and control, elements of production control, types of production, organization of production planning and control department, internal organization of department.

UNIT-II

FORECASTING: Forecasting, importance of forecasting, types of forecasting, their uses general principles of forecasting, forecasting techniques, qualitative methods and quantitative methods.

UNIT-III

INVENTORY MANAGEMENT: Inventory control, Purpose of holding stock-Effect of demand on inventories-Ordering procedures. Two bin system, Determination of Economic order quantity and economic lot size-ABC analysis-Recorder procedure, Material Requirements Planning (MRP).

UNIT–IV

ROUTING : Routing, definition, routing procedure, route sheets, bill of material, factors affecting routing procedure, schedule, definition, difference with loading,

UNIT-V

PRODUCTION SCHEDULING: Production Control Systems-Loading and scheduling, Master Scheduling-Scheduling rules, Line of balance, Flow production scheduling.

DISPATCHING: Dispatching, activities of dispatcher, dispatching procedure, follow up, applications of computer in production planning and control.

TEXT BOOKS:

1. Elements of Production Planning and Control, Samuel Eilon.
2. Production Planning and Control, Mukhopadyay, PHI.

REFERENCE BOOKS:

1. Production Planning Control and Industrial Management, K.C.Jain& L.N. Aggarwal, Khanna Publishers, 6th Edition, 2008.
2. Theory and Problems in Production & Operations Management, S.N.Chary, Tata McGrawHill, 2003.
3. Production and Operations Management, N.G. Nair,Tata McGraw-Hill, 2004

WEB LINKS:

1. http://www.ddegjust.ac.in/2017/Uploads/11/POM-326.pdf
2. https://mrcet.com/downloads/digital_notes/ME/IV%20year/PPC%20NOTES.pdf
3. https://getmyuni.azureedge.net/assets/main/study-material/notes/mechanical_engineering_industrial-engineering-operation-research_production-planning-and-control_notes.pdf
4. http://www.velhightech.com/wp-content/uploads/2019/04/IE6605-Production-Planning-and-Control-IV-YEAR-VIII-SEM-converted.pdf

IV B.TECH I SEMESTER Professional Elective-V	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20ME4116	**ELECTRIC AND HYBRID VEHICLES**						

COURSE OUTCOMES:

CO1: Tabulate different kinds HEVs
CO2: Summarize the working of different components of HEV
CO3: Demonstrate the components of Electric Drive Train
CO4: Identify the functions and requirements of storage systems
CO5: Illustrate the modelling aspects of HEVs

UNIT – I:

INTRODUCTION TO ELECTRIC VEHICLE: History of Electric Vehicles, Development towards 21st Century, Types of Electric Vehicles in use today – Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, and Solar Powered Vehicles.

MOTION AND DYNAMIC EQUATIONS OF THE ELECTRIC VEHICLES: various forces acting on the Vehicle in static and dynamic conditions.

UNIT – II:

INDUCTION TO HYBRID ELECTRIC VEHICLE: Social and environmental importance of hybrid and electric vehicles, impact of modern drive-trains on energy supplies.

Hybrid Electric Drive-trains: Basic concept of hybrid traction, introduction to various hybrid, Drive-train topologies, power flow control in hybrid drive-train topologies, fuel efficiency analysis.

UNIT – III:

ELECTRIC DRIVE TRAINS: Basic concept of electric traction, introduction to various electric drive train topologies, power flow control in electric drive-train topologies, fuel efficiency analysis.

ELECTRIC PROPULSION UNIT: Introduction to electric components used in hybrid and electric vehicles, Configuration and control of DC Motor drives, Configuration and control of Induction Motor drives, configuration and control of Permanent Magnet Motor drives, Configuration and control of Switch Reluctance Motor drives, drive system efficiency.

UNIT – IV:

TYPES OF STORAGE SYSTEMS: Introduction to Energy Storage Requirements in Hybrid and Electric Vehicles, Battery based energy storage and its analysis, Fuel Cell based energy storage and its analysis, Super Capacitor based energy storage and its analysis, Flywheel based energy storage and its analysis, Hybridization of different energy storage devices. Sizing the drive System.

UNIT – V:

MODELLING OF HYBRID ELECTRIC VEHICLE RANGE:

Driving Cycles, Types of Driving Cycles, Range modelling for Battery Electric Vehicle, Hybrid (ICE & others), Fuel Cell EV, Solar Powered Vehicles. Case study of 2 wheeler, 3 wheeler and 4 wheeler vehicles.

TEXT BOOKS:

1. James Larminie, J. Lowry, "Electric Vehicle Technology Explaned", John Wiley & Sons Ltd. 2003.
2. M. Ehsani, Y. Gao, S. E. Gay and A. Emadi, "Modern Electric, Hybrid Electric, and Fuel Cell Vehicles: Fundamentals, Theory, and Design", CRC Press, 2004.

REFERENCES:

1. S. Onori, L. Serrao and G. Rizzoni, “Hybrid Electric Vehicles: Energy Management Strategies”,Springer, 2015.
2. Iqbal Hussein, “Electric and Hybrid Vehicles: Design Fundamentals”, CRC Press, 2003.

IV B.TECH I SEMESTER Humanity & Social Science Elective	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC4101	**BUSINESS MANAGEMENT CONCEPTS FOR ENGINEERS**						

COURSE OBJECTIVE:

1. To provide an insight into the various economic concepts which are necessary for taking decisions related to economic aspects of the organization.
2. To provide familiarity with the accounting concepts which will help in preparation of various accounting records
3. To equip the student with the basic management concepts and functions and to provide knowledge relating to recruitment, selection, training, and motivation of employees in the organization

COURSE OUTCOMES: The student is able to

CO1: Summarize fundamentals of Managerial economics for decision making (K2).

CO2: Apply concepts of Financial Accounting and BEP for business decisions (K3).

CO3: Evaluate fundamental concepts and principles of management (K5).

CO4: Discuss functional areas of management like HR, marketing and finance (K6).

CO5: Apply project management techniques for project planning and evaluation (K3).

UNIT-I: INTRODUCTION TO MANAGERIAL ECONOMICS

Definitions, - Nature And Scope- Relation With Other Subjects- Demand Definition- Determinants- Law of Demand and Its Exceptions- Concept of Elasticity of Demand- Cost Concepts- CVP Analysis (With Simple Problems), Significance- Limitations.

UNIT-II: MARKET STRUCTURES AND FINANCIAL ACCOUNTING

Introduction to Markets – Features of various markets-Perfect competition, Monopoly and Oligopoly. Definition – Importance, limitations and basic books of financial accounting, Preparation of basic books of accounting: journal, ledger and trail balance.

UNIT-III: INTRODUCTION TO MANAGEMENT

Concept, Nature, Importance- Functions of Management- Henry Fayols Principles of Management- F.W.Taylors Scientific Management- Douglas Mc Gregors Theory X and Y.

UNIT-IV: FUNCTIONAL AREAS OF MANAGEMENT

Concept of HRM, Functions of HR Manager- Marketing Management- Functions of Marketing Manager- Production Management-Functions of Production Management – Financial Management and functions of Financial Management.

UNIT-V: PROJECT MANAGEMENT: (PERT/CPM)

Development of Network – Difference between PERT and CPM- Problems on Critical Path- Problems on PERT Analysis.

TEXT BOOKS

1. Dr. N. APPARAO Dr. P. Vijay Kumar: "Managerial economics and financial analysis" Cengage publication's, New Delhi-2011.
2. Dr. A. R. Aryasri- Managerial Economics and Financial Analysis, TMH2011.
3. V. Maheswari: Managerial Economies, Sultan Chand.
4. Suma Damodaran: Managerial Economics, Oxford 2011.
5. Koontz & Weihrich: Essentials of Management" TMH 2011.

REFERENCES:

1. Managerial economics theory & applications, DM Mithani, Himalaya Publishing House, 2013
2. Accounting For Managers, G. Prasad, Jaibharath Publishers, 2016.
3. Dr. P. Vijaya Kumar & Dr. N. Appa Rao," Management Science" cengage. Delhi, 2012.
4. Project Planning & Control with PERT & CPM, BC Punmia & KK Khandelwal, Lakshmi Publications, New Delhi, 4th Edition – 2016.

IV B.TECH I SEMESTER Humanity & Social Science Elective	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	3	0	0	30	70	100	3
Code: R20CC4117	**ENTREPRENEURSHIP & INNOVATION**						

COURSE OBJECTIVE:

1. Creating awareness among the students about the significance of entrepreneurship and its social relevance.
2. Imparting knowledge to the students on institutional support available to start a business venture
3. To understand the significance of entrepreneurial training in the development of new and existing entrepreneurs

COURSE OUTCOME: The student is able to

CO1 : Outline the concepts of Entrepreneurship.[K2]
CO2 : Create the awareness on creativity and innovation.[K6]
CO3 : Adopt the Entrepreneurship Development programs[K6]
CO4 : Evaluate the project planning and feasibility studies.[K5]
CO5 : Analyze the concept of small and micro enterprises.[K4]

SYLLABUS:

UNIT –I: ENTREPRENEUR AND ENTREPRENEURSHIP

Entrepreneur – Definitions, concept of entrepreneur, characteristics of entrepreneur, types of entrepreneurs, concept of entrepreneurship, characteristics of entrepreneurship, role of entrepreneurship in economic development, ethics and social responsibilities of an entrepreneur, Financial institutional support to entrepreneurs(IDBI,SISI,DIC,NIESBUD, Commercial banks etc.,

UNIT-II: CREATIVITY AND INNOVATION IN ENTREPRENEURSHIP

Meaning and concept of creativity - Nature and characteristics of creativity -Creativity Process- Factors affecting creativity - Meaning and Importance Innovation - Process -Distinguish the Creativity and Innovation.

UNIT –III: ENTREPRENEURSHIP DEVELOPMENT PROGRAMMES

Designing Appropriate Training Programme to inculcate Entrepreneurial Spirit -Training for Entrepreneurs, Entrepreneurship Development Programme (EDP) – Need and objectives of EDP's - Phases and evolution on EDP's existing and new Entrepreneurs.

UNIT –IV: PROJECT PLANNING AND FEASIBILITY STUDIES

Meaning of a project, Project identification – Sources of new Ideas, Methods of generating ideas, Project selection**,** - Project Feasibility Study -Project evaluation and Techniques (PBP, ARR, NPV, IRR & PI).

UNIT –V: SMALL AND MICRO ENTERPRISES

Importance, definitions, MSME's Development Act 2006 – policies and their support to MSMEs - Growth of Firm and growth strategies, Factors inducing growth – sickness in small business and remedies.

TEXT BOOKS:

2. "Entrepreneurship", Arya Kumar: Pearson, Publishing House, New Delhi, 2012.
3. "Entrepreneurship', VSP Rao, Kuratko: Cengage Learning, New Delhi,2012
4. Shoimo Maital, DVR Seshadri, "Innovation Management", Response Books 2007

REFERENCES:

1. "Entrepreneurship Development" B.Janakiram, M Rizwana: Excel Books, ND, 2011
2. "Entrepreneurship Development", P.C.Shejwalkar Everest Publishing House, ND, 2011
3. Vinnie Jauhari & Sudhanshu Bhushan, "Innovation Management". Oxford University Press, 2014.

IV B.TECH I SEMESTER	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	1	0	2	-	50	50	2
Code: R20ME41SC4	**MECHATRONICS & SIMULATION LAB**						

COURSE OBJECTIVES

The course content enables students to:

- The course in intended to provide knowledge of basic mechatronics elements, system level integration, control and robotics.
- This lab imparts skill and knowledge on Modular Automation Production Systems by implementing the automation skills achieved from Basics of PLC
- Candidates are trained on the ANSYS and/or 3D Experience SIMULIA Modules to gain the first-hand experience of simulation and analysis of mechanical systems.

COURSE OUTCOMES:

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

CO1: Interpret and operate on PLC and mechatronic systems

CO2: Use of various analytical tools like ANSYS, Fusion 360 etc., for engineering simulation.

List of Experiments:

This lab has been divided into two streams namely mechatronics lab and simulation lab. Mechatronics lab has more exposure towards PLC, actuator & sensor controls, and modelling & planning for different kinds of mechanisms for position control systems. Simulation lab will give an overall exposure towards structural analysis, thermal analysis and modal analysis.

MECHATRONICS LAB:

1. Ladder programming for Water Level Indicator & Controlling System
2. Ladder programming for Automatic Traffic Control System
3. Ladder programming for Automatic Liquid Filling and Mixing System.
4. Ladder programming for Industrial Time Controller.
5. Characteristics of LVDT

SIMULATION LAB:

1. To determine the Deflection and Member forces of a given 2D truss.
2. To find the displacement, maximum, minimum stresses induced in a given cantilever beam with uniformly distributed load and point loads and draw the shear force and bending moment diagrams by using simulation tool, also list the results according to the given loads.
3. To find the displacement, maximum, minimum stresses induced in a given simple supported beam with uniformly distributed load and point loads and draw the shear force and bending moment diagrams by using simulation tool, also list the results according to the given loads.
4. Analysis of Plane Stress, Plane Strain and Axisymmetric Problems
5. Steady state heat transfer Analysis of plane and axisymmetric components.

IV B.TECH– II SEMESTER

S. No	Subject	Course Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Major Project & Internship	R20CC42PW	PR				0	0	0	**12**
						Total				**12**
						Credits Grand Total				**160**

POOL - 1
AUTOMOTIVE DESIGN

S. No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Automobile Engine Design	R20MEHN01	PC	30	70	100	4	0	0	4
2	Automotive Transmission	R20MEHN02	PC	30	70	100	4	0	0	4
3	Autotronics and Safety	R20MEHN03	PC	30	70	100	4	0	0	4
4	Alternative Energy Sources for Automobiles	R20MEHN04	PC	30	70	100	4	0	0	4

II B.TECH II SEMESTER POOL 1	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN01	**AUTOMOBILE ENGINE DESIGN**						

COURSE OBJECTIVES:

- To present a problem oriented in depth knowledge of automobile engine component design.
- To address the underlying concepts and methods behind automobile engine component design.

COURSE OUTCOMES:

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

CO1: Describe the Design and assembly considerations of Automobile Components.
CO2: Estimate the requirements of piston cylinder assembly.
CO3: Design different Crank shafts using balancing techniques.
CO4: Analyze the working of different types of flywheels using design considerations.
CO5: Design valves and valve train components for different types of Engines.

UNIT-I

INTRODUCTION: Engineering materials - Introduction endurance limit, notch sensitivity. Tolerances, types of tolerances and fits, design considerations for interference fits, surface finish, surface roughness, Rankine's formula - Tetmajer's formula - Johnson formula- design of pushrods.

UNIT-II

DESIGN OF CYLINDER, PISTON AND CONNECTING ROD

Choice of material for cylinder and piston, design of cylinder, piston, piston pin, piston rings, piston failures, lubrication of piston assembly. Material for connecting rod, determining minimum length of connecting rod, small end design, shank design, design of big end cap bolts.

UNIT-III

DESIGN OF CRANKSHAFT: Balancing of I.C. engines, significance of firing order. Material for crankshaft, design of crankshaft under bending and twisting, balancing weight calculations, development of short and long crank arms. Front and rear-end details.

UNIT-IV

DESIGN OF FLYWHEELS: Determination of the mass of a flywheel for a given co- efficient of speed fluctuation. Engine flywheel -stresses on the rim of the flywheels. Design of hubs and arms of the flywheel, turning moment diagram.

UNIT-V

DESIGN OF VALVES AND VALVE TRAIN: Design aspects of intake & exhaust manifolds, inlet & exhaust valves, valve springs, tappets and valve train. Design of cam & camshaft. Design of rocker arm. Cam profile generation.

TEXT BOOKS:

1. Giri.N.K, "Automobile Mechanics", Khanna Publishers, New Delhi, 2007.
2. Machine Design by R.S.Khurmi & J.K.Gupta, S.Chand & Co

REFERENCE BOOKS:

1. Design of machine Elements by Bhandari, Tata McGraw-Hill Publishing Company Ltd
2. Machine Design by Sharma-Agarwal, S.K.Kataria & Sons

WEB REFERENCES:

1. https://books.google.co.in/books?id=ZYrZzQEACAAJ&dq=Automotive+Engine+Components+Design&hl=te&sa=X&ved=2ahUKEwiAi4y-0fLtAhUy4jgGHbmHCTgQ6AEwAHoECAQQAg

II B.TECH II SEMESTER POOL 1	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN02	**AUTOMOTIVE TRANSMISSION**						

COURSE OBJECTIVES:

- The course aims to impart basic skills and understanding of automobile transmission systems basic components their working principle, classification and performance characteristics.

COURSE OUTCOMES:

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

CO1: Illustrate the basic working principles of basic elements of automobile transmission system.
CO2: Analyze Constructional details of gear box for effective of transmission.
CO3: Examine Constructional details of hydrodynamic drives.
CO4: Compare the construction and working of different hydrostatic drives.
CO5: Distinguish different types of electric and automatic drives for automobiles.

UNIT-I

CLUTCH: Principle of operation, Constructional details, calculation of torque capacity, axial force. Different types of clutches, Operation of single plate helical spring, diaphragm type, and multiplate clutch, Centrifugal and Automatic Clutch, Dry and Wet type of clutch, Friction lining materials. Over-running clutch. Modes of operating a clutch – mechanical, hydraulic and electric, clutch maintenance

UNIT-II

GEAR BOX: Objective of the Gear Box, Determination of gear ratios for vehicles, Performance characteristics in different speeds, Different types of gear boxes – sliding, constant and synchromesh type, Planetary gear box, need for double declutching and working of synchronizing unit. Power and economy modes in gearbox, Transfer box, Transaxles, Overdrives. Gear shifting mechanisms, mechanical link and wire types, Gear box maintenance.

UNIT-III

HYDRODYNAMIC DRIVE: Fluid coupling, Principle of operation, Constructional details, Torque capacity, Performance characteristics, Reduction of drag torque, Torque Converter-Principle of operation, constructional details, performance characteristics, Converter coupling – Construction - Free wheel – Characteristic performance

UNIT-IV

HYDROSTATIC DRIVE: Hydrostatic drive – principle, types, advantages, limitations - Comparison of hydrostatic drive with hydrodynamic drive - Construction and working of typical Janny hydrostatic drive

UNIT-V

AUTOMATIC TRANSMISSION APPLICATIONS: Chevrolet "Turbo glide" Transmission, Power glide Transmission Toyota "ECT-i" Automatic Transmission with Intelligent Electronic controls system, Hydraulic Actuation system. Study of drive system in an electric and hybrid vehicle

TEXT BOOKS:

1. Automotive Transmission and Power Trains construct Crouse. W.H., Anglin., D.L., McGraw-Hill.
2. Fundamentals of Automotive Technology: Principles and Practice, Jones & Bartlett Publishers, CDX Automotive, 2013.

REFERENCES:

1. Modern Transmission systems, Judge.A.W., Chapman and Hall Ltd.
2. Automobile Engineering Kirpal Singh, Vol-1
3. Automobile Engineering P S Gill, Vol-II, S K Kataria & Sons, 2014
4. Newton Steeds & Garrot, Motor Vehicles, SAE International and Butterworth Heinemann, 2001.
5. SAE Transactions 900550 & 930910.

Web resources:

1. http://nptel.ac.in/
2. www.learnerstv.com
3. http://auto.howstuffworks.com/
4. nptel.iitk.ac.in/

II B.TECH II SEMESTER POOL 1	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN03	**AUTOTRONICS AND SAFETY**						

COURSE OBJECTIVES:

- The purpose of this course is to introduce to students to learn about automotive electronics and the fundamentals of the electronic systems and circuits used in automobiles. Study about comfort, security and safety systems.

COURSE OUTCOMES:

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

CO1: Illustrate different types of electronic components used in automotive systems.
CO2: Examine different types of dash board and control of automotive vehicles.
CO3: Examine comfort and security systems of automotive vehicles.
CO4: Illustrate different safety systems available for automobile.
CO5: Distinguish types of solar vehicles and its performance.

UNIT-I

FUNDAMENTALS OF AUTOMOTIVE ELECTRONICS: Microprocessor and micro computer applications in automobiles, components for engine management system, Electronic management of chassis system. Batteries, starter motor & drive mechanism.

UNIT-II

DASH BOARD & CONTROL: Electromagnetic compatibility Electronic dash board instruments - On board diagnosis system. Security and warning system. Types of EMS, Electromagnetic interference Suppression.

UNIT-III

COMFORT & SECURITY SYSTEMS: Seats, mirrors and sun roofs; central locking and electronic Windows, power steering, cruise control, in-car multimedia, airbag and belt tensioners, Types of Rear-View Mirrors and their Assessment. Security systems- Anti-Theft Technologies.

UNIT-IV

SAFETY SYSTEMS: Active and Passive Safety Systems, Airbags, types of safety Belts, Seat Belt Tightening System, Collision Warning Systems, Child Lock, Anti-Lock Braking Systems. Crash Worthiness of Vehicle. Design of Seats for Safety- Types of Seats Used in Automobiles. Introduction to the Types of Safety Glass and Their Requirements.

UNIT-V

SOLAR ELECTRIC VEHICLES: Introduction, types of electric vehicles, solar cell, operation of a solar cell, solar array, power trackers, electric motor, solar power cars, buses, solar powered space craft, Applications and limitations.

TEXT BOOKS:

1. Understanding automotive electronics, 5th edition, Willium b. Ribbens - Butter worth Heinemann Woburn, 1998.
2. Automotive Electricity and Electronics, Al Santini, Delmar Publishers, NY, ISBN 0-8273- 6743-0

REFERENCES:

1. Automotive Electronics Handbook, Ronald K. Jurgen, McGraw Hill Publishing Co., ISBN 0- 07-034453-1.
2. Automobile Electrical & Electronic Equipments, Young, Griffitns, Butterworth Publication, London.
3. Understanding Automotive Electronics, Bechfold, SAE 1998.

WEB REFERENCES:

1. https://www.electronicsweekly.com/market-sectors/automotive-electronics/
2. https://www.continental-automotive.com/en-gl/PassengerCars/Vehicle Networking/Comfort-Security

II B.TECH II SEMESTER POOL 1	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN04	**ALTERNATE ENERGY SOURECES FOR AUTOMOBILES**						

COURSE OBJECTIVES:

- Describe need for alternative fuels for Internal combustion engine and alternative drive systems for automobiles
- Describe principle of solar energy collection, construction of photo voltaic cells
- Explain various properties, methods of production of Bio gas, methanol, ethanol, Bio diesel
- Explain use of hydrogen for internal combustion engine application.
- Describe use of various gaseous fuels for internal combustion engine application.

COURSE OUTCOMES:

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

CO1: Explain various properties, methods of production of Bio gas, methanol, ethanol,
CO2: Explain use of hydrogen for internal combustion engine application.
CO3: Distinguish various properties, methods of production of duel fuel technology.
CO4: Describe need for alternative fuels for internal combustion engine and alternative drive systems for automobiles
CO5: Analyze various properties, methods of production of Bio diesel

UNIT-I

BIOGAS: History, properties and production of Biogas, classification of biogas plants, biogas storage and dispensing system. Advantages of biogas, hazards and emissions of biogas. Production, properties, Engine performance, advantages and disadvantages of Methanol, Ethanol, Butanol, Straight vegetable oil, Biodiesel for internal combustion engine application.

UNIT-II

HYDROGEN: Properties and production of hydrogen, Storage, Advantages and disadvantages of hydrogen, use of Hydrogen in SI and CI engines. Hazards and safety systems for hydrogen, hydrogen combustion. Emission from hydrogen.

GASEOUS FUELS: Production, properties, Engine performance, advantages and disadvantages of CNG, LNG, ANG, LPG and LFG.

UNIT-III

ALTERNATIVE POWER TRAINS: Components of an EV, EV batteries, chargers, drives, transmission and power devices. Advantages and disadvantages of EVs. Hybrid electric vehicles, HEV drive train components, advantages of HV. History of dual fuel technology, Applications of DFT. Duel fuel engine operation. Advantages and disadvantages of duel fuel technology.

UNIT-IV

NEED FOR ALTERNATIVE FUELS: Effects of constituents of Exhaust gas emission on environmental condition of earth (N2, CO2, CO, NOx, SO2, O2) Pollution created by Exhaust gas emission in atmosphere. Greenhouse effect, Factors affecting greenhouse effect. Study of Global Carbon Budget, Carbon foot print and Carbon credit calculations. Emission norms as per Bharat Standard up to BS – IV and procedures for confirmation on production

UNIT-V

BIO DIESELS: Base materials used for production of Bio Diesel (Karanji oil, Neemoil, Sunflower oil, Soyabeen oil, Musturd oil, Palm oil, Jatropha seeds). Process of separation of Bio Diesel. Properties Diesel blended with vegetable oil, and difference in performance of Engine

TEXT BOOKS:

1. Alternative Fuels- S .S. Thipse. JAICO Publishing House.
2. Non-Conventional Energy Sources- G. D. Rai Khanna Publishing New Delhi.

REFERENCE BOOKS:

1. Alternative fuels for Vehicle – M. Poulton
2. Alternative fuels guide – R. Bechtold.SAE
3. Alternative energy sources -T.N Veziroglu, McGraw Hill

Web References:

1. https://www.lgm.ca/blog/six-alternative-fuel-sources-for-cars
2. https://afdc.energy.gov/fuels/
3. https://www.sciencedaily.com/terms/alternative_fuel_vehicle.htm

POOL-2
ROBOTICS AND MECHATRONICS

S. No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Robotics Modelling & Analysis	R20MEHN05	PC	30	70	100	4	0	0	4
2	Modelling and Analysis of Dynamic Systems	R20MEHN06	PC	30	70	100	4	0	0	4
3	Theory and Design of Control Systems	R20MEHN07	PC	30	70	100	4	0	0	4
4	Smart Materials for Mechatronic applications	R20MEHN08	PC	30	70	100	4	0	0	4

III B.TECH I SEMESTER POOL 2	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN05	**ROBOTICS MODELLING & ANALYSIS**						

COURSE OBJECTIVES

1. Introduce the concepts of Robotic system, its components and control related to robotics.
2. Learn about analyzing robot kinematics.

COURSE OUTCOMES

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

CO1: **Distinguish** between automation and robotics and **identify** various components of robot.
CO2: **Analyze** kinematics of a robot
CO3: **Analyze** Dynamics of a robot
CO4: **write** a programme to control a robot for execution of a work cycle
CO5: **Illustrate** present and future applications of robots

UNIT – I:

Introduction

Automation and Robotics: Components of Robot – Mechanical manipulator control system and end effectors-Types of end effectors — Requirements and challenges of end effectors classification of robots by coordinate system and control system. Control resolution, accuracy, repeatability and work volume of robot.

Actuators: Pneumatic, Hydraulic actuators, electric & stepper motors.

Feedback components: position sensors – potentiometers, resolvers, encoders –velocity sensors.

UNIT – II: Motion Analysis

Homogeneous transformations as applicable to rotation and translation –problems.

Manipulator Kinematics: Specifications of matrices, D-H notation joint coordinates and world coordinates Forward and inverse kinematics – problems

UNIT – III:

Robot Dynamics: Differential transformation and manipulators, Jacobeans – problems, Lagrange – Euler and Newton – Euler formations – Problems

UNIT – IV:

Trajectory planning:

Trajectory planning and avoidance of obstacles, path planning, Slew motion, joint integrated motion – straight line motion – Robot programming, languages and software packages.

UNIT – V:

Robot Application in Manufacturing

Material Transfer - Material handling, loading and unloading- Processing – spot and continuous arc welding & spray painting - Assembly and Inspection. Future applications of robots.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. Robotics and Control / Mittal R K & Nagrath I J / TMH.

REFERENCE BOOKS:

1. Robotics / Fu K S/ McGraw Hill.
2. An Introduction to Robot Technology, / P. Coiffet and M. Chaironze / Kogam Page Ltd. 1983 London
3. Robotic Engineering / Richard D. Klafter, Prentice Hall.
4. Robot Analysis and Intelligence / Asada and Slow time / Wiley Inter-Science.
5. Introduction to Robotics / John J Craig / Pearson Edu.
6. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.

WEB RESOURCES:

1. https://www.intechopen.com/books/robotic-systems-applications-control-andprogramming.
2. http://planning.cs.uiuc.edu/node659.html
3. https://www.edx.org/course/robot-mechanics-and-control-part-i
4. https://www.edx.org/course/robotics-foundation-ii-robot-control
5. https://nptel.ac.in/courses/112/105/112105249/
6. http://www.robotictutorials.com/ ___for tutorials
7. ARC lab material – in house Dept. of Mechanical Engineering, NEC
8. http://vlabs.iitkgp.ernet.in/rislab/
9. http://www.mind.ilstu.edu/teachers/labs/robot/
10. http://vlab.amrita.edu/?sub=3&brch=271&sim=1642&cnt=3525
11. https://www.virtualroboticstoolkit.com/
12. https://www.robotlab.com/blog/robotlab-is-offering-free-online-virtual-robotics-andcoding-courses-to-those-affected-by-covid-19

III B.TECH I SEMESTER POOL 2	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN06	**MODELLING AND ANALYSIS OF DYNAMIC SYSTEMS**						

COURSE OBJECTIVES:

- To teach students basic mathematical and computational tools for modelling and analysis of dynamic systems.
- To train students to identify, model analyze, design, and simulate dynamic systems in various engineering disciplines using a unified approach.

COURSE OUTCOMES:

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

CO 1: **Examine** the Mechanical Systems and Models in engineering disciplines.

CO 2: **Examine** the Electrical, Electronic, And Electromechanical Systems and Models in engineering disciplines.

CO 3: **Examine** the Fluid and Thermal Systems and Models in engineering disciplines.

CO 4: **Analyze** the Transient response of First-Order Systems and Second-Order Systems in MAT Lab

CO 5: **Analyze** the Frequencyresponse of First-Order Systems and Second-Order Systems in MAT Lab

UNIT-I:

INTRODUCTION: System Dynamics, Classification of System Inputs. System Models.

MECHANICAL SYSTEMS: Mechanical Elements- Mass Elements. Spring elements, Damper Elements, Translational Systems – Newton's Second Law, Free Body Diagram, Massless Junctions, Alembert's Principle, Rational Systems - General Moment Equation.

UNIT-II:

ELECTRICAL SYSTEMS: Electrical Elements – Resistors, Inductors, Capacitors, Electric Circuits - Kirchhoff's Voltage Law, Kirchhoff's Current Law, Node Method, Loop Method,

ELECTROMECHANICAL SYSTEMS: Elemental Relations of Electromechanical Systems - Armature-Controlled Motors, Field-Controlled Motors, Impedance Methods - Impedances of Electric Elements, Series and Parallel Impedances, Mechanical Impedances.

UNIT-III:

FLUID SYSTEMS: Pneumatic Systems - Ideal Gases, Pneumatic Capacitance, Modeling of Pneumatic Systems, Liquid-Level Systems - Hydraulic Capacitance, Hydraulic Resistance, Modeling of Liquid-Level Systems,

THERMAL SYSTEMS: First Law of Thermodynamics, Thermal Capacitance, Thermal Resistance, Modeling of Heat Transfer Systems.

UNIT-IV:

TRANSIENT RESPONSE: First-Order Systems - Free Response - Impulse Response - Step Response - Ramp Response. Second-Order Systems - Free Response - Initial Response in MATLAB.

UNIT-V:

FREQUENCY RESPONSE: Stable, Linear Systems, First-Order Systems, Second-Order Systems, Bode Diagram - Plotting Bode Diagrams in MATLAB - First-Order Systems - Second-Order Systems

TEXT BOOKS:

1. Ramin S. Esfandiari, and Bei Lu, "Modelling and Analysis of Dynamic Systems", 2nd Edition, CRC Press.
2. Ernest O. Deobelin, " System Dynamics – Modelling, Analysis, Simulation , Design ",Marcel Decker.

REFERENCE BOOKS:

1. W. J. Plam III, "System Dynamics", 3rd Edition, McGraw Hill, 2014.
2. Modeling and Analysis of Dynamic Systems, 3rd Edition, Charles M. Close, Dean K. Frederick, Jonathan C. Newell
3. K. Ogata, "System Dyanmics", 4th Edition, Prentice Hall, 2004

WEB REFERENCES:

1. https://nptel.ac.in/courses/112107214
2. https://m6as2757qi.pdcdn1.top/dl2.php?id=17559382&h=8fdb1538dbe4b84f971a5ad16463a229&u=cache&ext=pdf&n=Modeling%20and%20analysis%20of%20dynamic%20systems%20second%20edition
3. https://doc.lagout.org/science/0_Computer%20Science/3_Theory/Non-Linear%20Systems,%20Modeling,%20Optimization/Modeling%20Of%20Dynamic%20Systems.pdf
4. https://www.cs.bham.ac.uk/~szh/teaching/matlabmodeling/Lecture2_body.pdf
5. https://edisciplinas.usp.br/pluginfile.php/4827346/mod_resource/content/1/Ernest%20Doebelin-System%20Dynamics-CRC%20Press%20%281998%29.pdf

III B.TECH I SEMESTER POOL 2	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN07	**THEORY AND DESIGN OF CONTROL SYSTEMS**						

COURSE OBJECTIVES:

- To equip the student with fundamental knowledge of dynamics of control systems design and theory so that student can appreciate
- Develop understanding of feedback characteristics and controller components of control systems.
- Develop knowledge of the state variables for linear continuous – time systems and linear discrete –time systems.

COURSE OUTCOMES:

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

CO1: Explain the developments of engineering design and control systems design
CO2: Analyze the mathematical models of physical systems for linear systems.
CO3: Explain the feedback characteristics and controller components of control systems.
CO4: Analyze the design of robust control systems and pid-controlled systems.
CO5: Evaluate the state variables for linear continuous – time systems and linear discrete –time systems.

UNIT – I:

CONTROL SYSTEMS: Introduction, History and Development of Automatic Control, Examples of Control Systems, Engineering Design, Control System Design, Mechatronic System, Green Engineering, Digital Computer Control, Future Evaluation of Control Systems.

UNIT – II:

MATHEMATICAL MODELS OF PHYSICAL SYSTEMS: Introduction, Differential Equations of Physical Systems, Linear Approximations of Physical Systems, Dynamics of Robotic Mechanisms, Transfer Functions of Linear Systems, Block Diagram Algebra, Signal Flow Graphs,

UNIT – III:

FEEDBACK CHARCTERISTICS: Feedback and Non-Feedback Systems, Reduction of Parametric Variations, Control over System Dynamics, Linearizing Effect of Feedback, Regenerative Feedback.
CONTROLLER COMPONENTS: Linear Approximations of Nonlinear Systems, Introduction, Controller Components, Stepper Motors, Hydraulic Systems, Pneumatic Systems.

UNIT – IV:

ROBUST CONTROL SYSTEM DESIGN: Preliminary Considerations of Classical Design, Robust Control Systems and System Sensitivity, Analysis of Robustness, the Design of Robust Control Systems and PID-Controlled Systems, Robust Internal Model Control System.

UNIT- V:

STATE VARIABLE ANALYSIS AND DESIGN: Concepts of State, State Variables and State model, State Models for Linear Continuous – Time Systems, State variables and Linear Discrete – Time Systems, Concept of Controllability and Observability, Observer Systems.

ADVANCES IN CONTROL SYSTEMS: Adaptive Control, Fuzzy Logic Control, Neural Networks.

TEXT BOOKS:

1. Control Systems Engineering, LJ Nagrath and M.Gopal, New Age International publications.
2. Modern Control Systems, Richard C.DORF & Robert H Bishop, Pearson Publications

REFERENCES:

1. Modern Control Systems, M.Gopal, New Age International publications.
2. Modern Control System Theory and Design, Stanley M. Shinners, Wiley Publications.
3. Control Systems Engineering, Dr D P Kothari, New Age International (P) Ltd Publishers.

WEB REFERENCES:

1. https://civildatas.com/download/control-systems-engineering-by-i-j-nagrath
2. https://wp.kntu.ac.ir/dfard/ebook/lc/Modern%20Control%20Systems,%2012th%20Edition_part1.pdf
3. https://nptel.ac.in/courses/107/106/107106081/

III B.TECH I SEMESTER POOL 2	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN08	**SMART MATERIALS FOR MECHATRONIC APPLICATIONS**						

COURSE OUTCOMES:

Upon successful Completion of the course, the student will be able to:

CO 1: Identify the use of smart materials in the manufacturing of complex Components.

CO 2: Classify the Shape memory Alloys and its applications.

CO 3: Use the techniques, skills, and modern engineering tools for design and control of EAPS.

CO 4: Classify the design, control and usage of different magnetostrictive materials. In engineering applications

CO 5: Compare and analyses the different applications of Smart materials

UNIT I:

INTRODUCTION: Smart materials and their application for sensing and actuation,

Piezoelectric materials: Piezoelectricity and piezoelectric Properties, Piezoelectric actuators, Control of piezoelectric actuators, Applications of piezoelectric actuators for precise positioning and scanning.

UNIT II:

SHAPE MEMORY ALLOYS (SMA): Properties of shape memory alloys, Shape memory effects, Pseudo-elasticity in SMA, Design of shape memory actuator, selection of materials, Smart actuation and control, Applications of SMA in precision equipment for automobiles, Locomotives and Medical devices.

UNIT III:

ELECTRO-ACTIVE POLYMERS (EAPs): Ionic polymer metal composites (IPMC), Conductive polymers, Carbon nanotubes, Dielectric elastomers, Design & control issues for EAP actuators, Applications of EAP for biomimetic, tactile display and medical devices.

UNIT IV:

MAGNETOSTRICTIVE MATERIALS: Basics of magnetic properties of materials, magnetostriction - constitutive equations, types of magnetostrictive materials, Magnetostrictive actuators, Applications.

UNIT V:

APPLICATIONS OF SMART MATERIALS: Comparative analysis of different smart materials based actuators, Future research trends of smart materials, smart materials based actuator technology.

TEXT BOOKS:

1. Jose L. Pons, Emerging Actuator Technologies, a Micromechatronics Approach, John Wiley & Sons Ltd, 2005
2. Ralph Smith, Smart Material Systems: Model Development, SIAM, Society for Industrial and Applied Mathematics, 2005

REFERENCES:

1. F. Carpi, D. De Rossi, R. Kornbluh, R. Pelrine, P. Sommer-Larsen, Dielectric Elastomers as Electromechanical Transducers, Elsevier, Hungry, 2008,

2. Y. B. Cohen, Electroactive Polymer (EAP) Actuators as Artificial Muscles Reality, Potential and Challenges, SPIE press, USA, 2004.

POOL- 3

PRODUCT DESIGN AND DEVELOPMENT

S. No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Advanced Mechanical Vibrations	R20MEHN09	PC	30	70	100	4	0	0	4
2	Product Design	R20MEHN10	PC	30	70	100	4	0	0	4
3	Flexible Manufacturing systems	R20MEHN11	PC	30	70	100	4	0	0	4
4	Rapid Prototyping	R20MEHN12	PC	30	70	100	4	0	0	4

III B.TECH II SEMESTER POOL-3	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN09	**ADVANCED MECHANICAL VIBRATIONS**						

COURSE OBJECTIVES

The course content enables students to:

- Understand Formulate mathematical models of problems in vibrations using Newton's second law or energy principles.
- Determine a complete solution to the modeled mechanical vibration problems.
- Correlate results from the mathematical model to physical characteristics of the actual system.
- Design of a mechanical system using fundamental principles developed in the class.

COURSE OUTCOMES

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

CO 1: Illustrate rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes),

CO 2: Determine simple spring mass systems, masses on tightly stretched strings, double pendulum, tensional systems.

CO 3: Analyze Numerical methods for multi DOF systems

CO 4: Analyze Seismic instruments, vibrometers, accelerometer, frequency measuring instruments

CO 5: Determine Impulse excitation, arbitrary excitation, Laplace transforms formulation, Pulse excitation and rise time, Shock response spectrum, Shock isolation.

UNIT-I:

FORCED VIBRATIONS (1DOF): Introduction**,** Basic Terminology, analysis of forced vibration with constant harmonic excitation, MF, rotating and reciprocating unbalances, excitation of support (relative and absolute amplitudes), force and motion transmissibility, energy dissipated due to damping and numerical problems

UNIT – II:

FORCED VIBRATIONS (2DOF):

Principal modes of vibrations, normal mode and natural frequencies of systems (Damping is not included), simple spring mass systems, masses on tightly stretched strings, double pendulum, tensional systems, combined rectilinear and angular systems, geared systems and numerical problems.

UNIT-III:

NUMERICAL METHODS FOR MULTI DOF SYSTEMS:

Maxwell's reciprocal theorem, influence coefficients, Rayleigh's method, Dunkerley's method, stodolamethod, orthogonality principle, method of matrix iteration and numerical.

UNIT-IV

VIBRATION MEASURING INSTRUMENTS AND WHIRLING OF SHAFTS:

Seismic instruments, vibrometers, accelerometer, frequency measuring instruments and numerical. Whirling of shafts with and without damping**.**

VIBRATION CONTROL:

Introduction, Vibration isolation theory, Vibration isolation and motion isolation for harmonic excitation, practical aspects of vibration analysis, vibration isolation, Dynamic vibration absorbers and Vibration dampers**.**

UNIT-V

TRANSIENT VIBRATION OF SINGLE DEGREE-OF FREEDOM SYSTEMS:

Impulse excitation, arbitrary excitation, Laplace transforms formulation, Pulse excitation and rise time, Shock response spectrum, Shock isolation.

RANDOM VIBRATIONS:

Random phenomena Time averaging and expected value, Frequency response function, Probability distribution, Correlation, Power spectrum and power spectral density, Fourier transforms and response.

TEXT BOOKS:

1. S. S. Rao, "Mechanical Vibrations", Pearson Education.
2. S. Graham Kelly, "Fundamentals of Mechanical Vibration" - McGraw-Hill.
3. "Theory of Vibration with Application" - William T. Thomson, Marie Dillon Dahleh,
4. Chandramouli Padmanabhan, 5th edition Pearson Education.
5. "Mechanical Vibrations", V. P. Singh, DhanpatRai& Company.
6. Mechanical Vibrations, W.T. Thomson W.T.- Prentice Hill Indi

REFERENCE BOOKS:

1. S. Graham Kelly, "Mechanical Vibrations", Schaum's Outlines, Tata McGraw Hill.
2. C Sujatha, "Vibraitons and Acoustics – Measurements and signal analysis", Tata McGraw Hill.
3. "Mechanical Vibrations", G. K. Grover, Nem Chand and Bros

WEB REFERENCES:

1. https://nptel.ac.in/courses/112/103/112103111/
2. https://nptel.ac.in/courses/112/103/112103112/#
3. http://ndl.iitkgp.ac.in/document/g_kDps3B9vQMV2-zacLwxKF4JxxfRzInbpuP0Kj_yXn-Y1tJl_y_j6U6A0-B_tE
4. https://www.springer.com/gp/book/9783030450731
5. http://160592857366.free.fr/joe/ebooks/Mechanical%20Engineering%20Books%20Collection/VIBRATIONS/mechVib%20theory%20and%20applications.pdf

III B.TECH II SEMESTER POOL-3	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN10	**PRODUCT DESIGN**						

COURSE OBJECTIVES:

- To understand the principles of generic development process; product planning; customer need analysis for new product design and development.
- To enhance the understanding of setting product specifications and generate, select, screen, and test concepts for new product design and development.
- To apply the principles of product architecture and the importance of industrial design principles and DFM principles for new product development.
- To expose the different Prototyping techniques, Design of Experiment principles to develop a robust design and importance to patent a developed new product.

COURSE OUTCOMES:

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

CO1: Apply the principles of generic development process; product planning; customer need analysis for new product design and development.

CO2: Set product specifications and generate, select, screen, test concepts for new product design and development.

CO3: Apply the principles of product architecture, industrial design and design for manufacturing principles in new product development.

CO4: Apply the adopt Prototyping techniques and Design of Experiment principles to develop a robust design and document a new product for patent.

CO5: Apply of the concepts of economics principles; project management practices in accelerating the new product development activity.

UNIT – I

INTRODUCTION TO PRODUCT DESIGN AND IDENTIFICATION OF CUSTOMER NEED: Need for IPPD - Strategic importance of Product development –Duration and Cost of Product Development – Challenges in Product Development – Product Development Processes and Organizations – Activities in Identifying Customer Needs.

UNIT – II

PRODUCT SPECIFICATIONS, CONCEPT GENERATION, SELECTION AND TESTING : Plan and establish Target and Final product specifications – Activities of Concept Generation - Task - Concept Selection methodology – Concept Screening and Scoring - Concept Testing Methodologies.

UNIT – III

PRODUCT ARCHITECTURE , INDUSTRIAL DESIGN AND DESIGN FOR MANUFACTURE : Product Architecture – Implications and establishing the architecture – Delayed Differentiation – Platform Planning - Need and impact of industrial design - Industrial design process - management of the industrial design process - assessing the quality of industrial design – DFM Definition - Estimation of Manufacturing cost- Reducing the component costs, costs of supporting function and assembly costs – Impact of DFM decision on other factors.

UNIT – IV

PROTOTYPING, ROBUST DESIGN AND INTELLECTUAL PROPERTY: Prototype basics - Principles of prototyping - Planning for prototypes - Robust design – Seven step process of Robust Design through Design of Experiments- Need and Importance of Intellectual Property – Seven step process of preparing a patent document.

UNIT – V

PRODUCT DEVELOPMENT ECONOMICS AND MANAGING PROJECTS: Economic Analysis – Elements of Economic Analysis - Understanding and representing tasks baseline project planning - accelerating the project - project execution – postmortem project evaluation.

TEXT BOOKS:

1. Karl T.Ulrich, Steven D.Eppinger, Anita Goyal, "Product Design and Development", McGraw –Hill Education (India) Pvt. Ltd, 4th Edition, 2012.
2. Kenneth Crow, "Concurrent Engineering/Integrated Product Development". DRM Associates, 6/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569,Workshop Book

REFERENCE:

1. Kevin N Otto, Kristin L Wood, “Product Design – Techniques in Reverse Engineering and New Product Development”, Pearson Education, Inc, 2016
2. Stephen Rosenthal, "Effective Product Design and Development", Business One Orwin, Homewood, 1992
3. Stuart Pugh, "Total Design – Integrated Methods for successful Product Engineering", Addison Wesley Publishing, Neyourk, NY, 1991.

WEB LINKS:

1. https://www.dexigner.com/directory/cat/Industrial-Design/Books
2. https://onlinecourses.nptel.ac.in/noc21_me83/preview
3. https://onlinecourses.nptel.ac.in/noc22_me11/preview

III B.TECH II SEMESTER POOL-3	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN11	**FLEXIBLE MANUFACTURING SYSTEMS**						

COURSE OBJECTIVES:

1. Get the knowledge of applying FMS in industries
2. Classify the parts cording coding system
3. Get the skill of modelling and design for critical systems

COURSE OUTCOMES:

CO1: Describe the Structure of FMS and types of workstations.
CO2. Describe part families, different types of coding system sin Group technology (GT)
CO3. Analyze the various levels of FMS, planning and control.
CO3. Explain the concepts of material handling, storage and retrieval systems.
CO4. List the layout of FMS.
CO5. Explain Computer Aided Process planning and contact and non-contact inspection techniques.

UNIT - I

INTRODUCTION: Types of production, characteristics, applications, need for FMS, Components of FMS, FMS layout configurations, planning the FMS, FMS's Work Stations.
FLEXIBLE MANUFACTURING CELL: Characteristics, Flexible Machining systems, achieving flexibility in machining systems, Machine cell design, quantitative techniques

UNIT - II

GROUP TECHNOLOGY (GT): —Part classification and coding systems: Part families, Optiz system, structure, Multicode, differences between Optiz and Multicode systems, relative benefits.
PRODUCTION FLOW ANALYSIS: Composite part concept, numerical problems for pads clustering. Advantages of GT in manufacturing and design.

UNIT - III

MATERIAL HANDLING SYSTEMS: Automatic Guided vehicle systems, automated storage and retrieval systems and Computer control systems.

UNIT - IV

IMPLEMENTING FMS: FMS Layout configurations, Quantitative Analysis methods for FMS, Applications and benefits of FMS, problems in implementing EMS.

UNIT - V

COMPUTER AIDED PROCESS PLANNING (CAPP): Importance, generative and retrieval systems, advantages and disadvantages, Generation of route sheets, selection of optimal machining parameters, methods.
COMPUTER AIDED QUALITY CONTROL (CAQC) AND COMPUTER AIDED TESTING (CAT): Coordinate measuring machines, over view, contact and non-contact inspection principles.

TEXT BOOK:

1. Automation, Production systems and Computer Integrated Manufacturing System — Mikell P. Groover.
2. The design and operation of FMS -Or. Paul Ranky Nort —Holland Publishers

REFERENCES:

1. Flexible Manufacturing systems in practice by Joseph talvage and roger G. Hannarn, Marcel Dekker Inc., New York
2. FMS and control of machine tools – V. Ratmirov, MIR publications
3. Flexible Manufacturing — David J. Parrish

Web References:

1. http://www.ignou.ac.in/upload/UNIT6-55.pdf
2. http://www.journals.elsevier.com/computer-aided-design
3. http://engineeringstudymaterial.net/ebook/flexible-manufacturing-system

III B.TECH II SEMESTER POOL-3	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	4	0	0	30	70	100	4
Code: R20MEHN12	**RAPID PROTOTYPING**						

COURSE OBJECTIVES:

- The course aims at the importance of Rapid Prototyping, classifications, models, specifications of various Rapid Prototype Techniques.
- To learn the different tools, soft-wares required and the applications of Rapid Prototyping.
- To know the principle methods, areas of usage, possibilities and limitations.
- Environmental effects of the Additive Manufacturing technologies

COURSE OUTCOMES:

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

CO 1: Identify the use of Rapid Prototyping Techniques in the manufacturing of complex Components.

CO 2: Classify the Stereo lithography Apparatus and its process.

CO 3: Illustrate the process of laminated object manufacturing and fused Deposition Modeling.

CO 4: Explain the Selective laser sintering process.

CO 5: Compare different method and discuss the effects of the Additive Manufacturing Technologies.

UNIT – I:

INTRODUCTION: Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process.

UNIT–II:

LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, layering technology, applications, advantages and disadvantages.

UNIT–III:

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) – models and specifications, process, working principle, applications, advantages and disadvantages

Fused Deposition Modelling (FDM) : Models and specifications, process, working principle, applications, advantages and disadvantages.

UNIT – IV:

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective Laser Sintering (SLS)- models and specifications, process, working principle, applications, advantages and disadvantages.

UNIT-V:

Additive Manufacturing: Overview – History – Need-Classification -Additive Manufacturing Technology in product development-Materials for Additive Manufacturing Technology – Tooling – Applications.

3D PRINTING: models and specifications, process, working principle, applications, advantages and disadvantages

TEXT BOOKS:

1. Rapid prototyping: Principles and Applications – Chua C.K., Leong K.F. and LIM C.S, World Scientific publications.
2. Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press

REFERENCE BOOKS

1. Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer.
2. Wholers Report 2000 – Terry Wohlers, Wohlers Associates.

WEB REFERENCES:

1. https://mosafavi.iut.ac.ir/sites/mosafavi.iut.ac.ir/files//.../rapid_prototyping_1_0.pdf
2. **https://www.cet.edu.in/noticefiles/258_Lecture%20Notes%20on%20RP-ilovepdf-compressed.pdf**

POOL 4

THERMAL SCIENCE AND ENGINEERING

S. No	Subject	Sub Code	Cat. Code	Internal Marks	External Marks	Total Marks	L	T	P	Credits
1	Advanced Thermodynamics	R20MEHN13	PC	30	70	100	4	0	0	4
2	Advanced Heat Transfer	R20MEHN14	PC	30	70	100	4	0	0	4
3	Gas turbines and Jet Propulsion	R20MEHN15	PC	30	70	100	4	0	0	4
4	Computational Fluid Dynamics	R20MEHN16	PC	30	70	100	4	0	0	4

IV B.TECH I SEMESTER POOL-4	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	30	70	100	4
Code: R20MEHN13	**ADVANCED THERMODYNAMICS**						

Course Objectives:

- To create awareness of the importance of thermodynamic principles in engineering Applications such as I.C engine combustion,
- To understand thermodynamic applications in psychometric, refrigeration and heat Transfer
- To understand the basic principles power cycles and its relation with combustion Processes
- To understand various methods of direct energy conversion

Course Outcomes:

CO1: A student will be able to apply various laws of thermodynamics for combustion Phenomena in IC engine

CO 2: A student will be able to select and design air conditioning or psychometric process Depending on application and comfort conditions.

CO 3: A student will be able to study of combustion phenomena in IC engines

CO 4: A student will be able to understand various energy conversion methods like fuel cells etc.

UNIT-I: Review Of Thermodynamic Laws and Corollaries: Transient flow analysis, Second law thermodynamics, Entropy, Availability and unavailability, Thermodynamic potential. Maxwell relations, Specific heat relations, Mayer's relation. Evaluation of thermodynamic properties of working substance

UNIT-II: Exergy: Concept of Exergy – second law efficiency, exergy change of a system, exergy transfer by heat, work and mass, the decrease of exergy principle and exergy destruction, Exergy balance for open and closed systems.

Irreversibility: Introduction - irreversibility for closed and open system – steady flow process - second law efficiency of steady flow devices.

UNIT-III: P-V-T Surface: Equation of state, Real gas behavior, Vander Waal's equation, Generalization compressibility factor, Energy properties of real gases, Vapor pressure, Clausius, Clapeyron equation, Throttling, Joule Thompson coefficient, Non-reactive mixtures of perfect gases. Governing laws, Evaluation of properties.

UNIT-IV

Combustion: Combustion Reactions, Enthalpy of formation. Entropy of formation, Reference levels of tables. Energy of formation, Heat reaction, Adiabatic flame temperature generated product Enthalpies, Equilibrium. Chemical equilibrium of ideal gas. The chemical potential and phase equilibrium, The Gibbs phase rule.

UNIT-V

Power Cycles: Review binary vapor cycle, co-generation and combined cycles, Second law analysis of cycles, Refrigeration cycles, Thermodynamics of irreversible processes, Introduction, Phenomenological laws, Onsager Reciprocity relation, Applicability of the Phenomenological relations, Heat flux and entropy production.

TEXT BOOKS:

1. Basic and Applied Thermodynamics, P.K.Nag, Tata McGraw Hill.
2. Thermodynamics, Holman, Tata McGraw Hill.

REFERENCE BOOKS:

3. Engineering Thermodynamics, PL.Dhar, Elsevier Publications
4. Thermodynamics for Engineers, Doolittle-Messe, John Wiley & Sons
5. Thermal Engineering, Soman, PHI Publishers

IV B.TECH I SEMESTER POOL-4	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	30	70	100	4
Code: R20MEHN14	**ADVANCED HEAT TRANSFER**						

Course Objectives

- To understand the basic principles of mass transfer occurring in process industry and other applications
- To study advanced heat transfer methods of two dimensional concepts
- To familiarize the basic concepts of various equations and empirical laws pertaining to convection and radiation and also phase transfer phenomena

Course Outcomes

CO 1: A student will be able to apply the laws of various modes of heat transfer depending on application

CO 2: A student will be able to solve two dimensional equations in Cartesian coordinates by exact methods

CO 3: A student will be able to calculate heat transfer rate associated with phase change heat transfer

CO 4: A student will be able to estimate mass diffusion phenomena applied to process Industries

UNIT-I

MODES OF HEAT TRANSFER: Conduction: General heat Conduction equation-initial and boundary conditions. Transient Heat Conduction: Lumped system analysis, Heisler charts-semi-infinite solid-use of shape factors in conduction-2D transient heat conduction-product solutions

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UNIT-II

FINITE DIFFERENCE METHODS FOR CONDUCTION: ID & 2D steady state and simple transient heat conduction problems-implicit and explicit methods.

FORCED CONVECTION: Equations of fluid flow-concepts of continuity, momentum equations-derivation of energy equation-methods to determine heat transfer coefficient: Analytical methods-dimensional analysis and concept of exact solution. Approximate method-integral analysis.

UNIT-III

EXTERNAL FLOWS: Flow over a flat plate: integral method for laminar heat transfer coefficient for different velocity and temperature profiles, Application of empirical relations to variation geometries for laminar and turbulent flows.

INTERNAL FLOWS: Fully developed flow: integral analysis for laminar heat transfer coefficient-types of flow-constant wall temperature and constant heat flux boundary conditions- hydrodynamic &thermal entry lengths; use of empirical correlations

UNIT-IV

FREE CONVECTION: Approximate analysis on laminar free convective heat transfer-Bossiness approximation-different geometries-combined free and forced convection.

BOILING AND CONDENSATION: Boiling curve-correlations-Nusselt's theory of film condensation on a vertical plate-assumptions & correlations of film condensation for different geometries.

UNIT-V

RADIATION HEAT TRANSFER: Radiant heat exchange in grey, non-grey bodies, with Transmitting, Reflecting and absorbing media, specular surfaces, gas radiation-radiation from flames.

GAS RADIATION: Radiation transfer in enclosures containing absorbing and emitting media - interaction of radiation with conduction and Convection.

TEXT BOOKS:

1. Principals of Heat Transfer, Frank Kreith, Cengage Learning
2. Elements of Heat Transfer, E. Radha Krishna, CRC Press/2012

REFERENCE BOOKS:

3. Heat Transfer, RK Rajput, S.Chand
4. Introduction to Heat Transfer, SK Som, PHI
5. Engineering Heat & Mass Transfer, Mahesh Rathore, Lakshmi Publications
6. Engineering Heat & Mass Transfer, Sarit K. Das, DhanpatRai

IV B.TECH I SEMESTER POOL-4	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	30	70	100	4
Code: R20MEHN15	**GAS TURBINES AND JET PROPULSION**						

COURSE OUTCOMES:

CO1: Tabulate different kinds of jet engines and rocket engines.
CO2: Demonstrate the concept of fluid Flow.
CO3: Identify the functions and flow characteristics of nozzle and diffusers
CO4: List the components of Ramjet and it uses
CO5: Discover the concepts of rocket propulsion, propellants

UNIT – I:

FUNDAMENTALS OF GAS TURBINE ENGINES:

Introduction and Basic review of thermodynamic concepts and Gas turbine cycle with regeneration, reheating and intercooling, various methods to improve efficiency and work output of gas turbine, Fundamentals of gas turbine engine use as aircraft power plant, turbojet, turbofan and turboprop engines.

UNIT – II:

GAS TURBINE COMBUSTION CHAMBER/BURNER:

Introduction and types of burners, Can burner, Annular burner, Cannular burner, Relative advantages and disadvantages of different types of burners, zones of combustion chamber, requirements of combustion chamber, design criteria of combustion chamber, pressure losses, combustion intensity and combustion efficiency, flame stabilization and flame holder, Design parameters of combustion chamber.

UNIT – III:

NOZZLE THEORY:

Basic review of thermodynamics and one dimensional isentropic flow, Area –Mach relation and types of nozzle, Exhaust velocity of nozzle, Mass flow rate through nozzle and choking of nozzle, Area ratio of nozzle, Effect of back pressure, Optimum expansion, under expansion and over expansion nozzle, Various nozzle configurations, Different Types of Nozzle.

UNIT – IV:

RAMJET PROPULSION:

Introduction and operating principle, Advantages, disadvantages, limitations and comparison with jet engines, Subcritical, critical and super critical operation, Ramjet performance, Simple design calculation of ramjet engine, Introduction to scramjet and preliminary concepts in supersonic combustion.

UNIT – V:

ROCKET PROPULSION:

Introduction to rocket propulsion and operating principle, Classification of rocket propulsion system, Introduction to solid propellant rockets and liquid propellant rockets.

TEXT BOOKS:

1. Gas Turbines, V. Ganesan, Tata McGraw Hill Publishers.
2. Mechanics and Dynamics of Propulsion, Hill and Peterson, John Wiley & Sons.

REFERENCES:

1. Gas Turbine Theory, Cohen and Rogers, Pearson Publishers.
2. Gas Turbines & Propulsive Systems, Khajuria & Dubey, Dhanpat Rai & Sons.
3. Rocket Propulsion, Ramamurthi, MacMilan Publishers

IV B.TECH I SEMESTER POOL-4	L	T	P	INTERNAL MARKS	EXTERNAL MARKS	TOTAL MARKS	CREDITS
	2	1	-	30	70	100	4
Code: R20MEHN16	**COMPUTATIONAL FLUID DYNAMICS**						

COURSE OBJECTIVES:

The course enables the students to:

1. Introduce them to widely used techniques in the numerical solution of fluid flow equations
2. Emphasize on „learning by doing", as they will work on class room projects and assignments.
3. Provide them with basic mathematical and numerical concepts of fluid flow and heat transfer problems.
4. Get exposed to modern trends in CFD.
5. Enhance their skills related to computer design and evaluation in fluid flow, critical thinking and lifelong learning

COURSE OUTCOMES:

At the end of the course, the students will be able to:

CO1: Understand the basic principles of mathematics and numerical concepts of fluid dynamics.
CO2: Develop governing equations for a given fluid flow system.
CO3: Adapt finite difference techniques for fluid flow models.
CO4: Apply finite difference method for heat transfer problems.
CO5: Solve computational fluid flow problems using finite volume techniques.
CO6: Get familiarized to modern CFD software used for the analysis of complex fluid-flow systems.

UNIT- I:

GOVERNING EQUATIONS OF FLUID FLOW: Introduction to CFD, Governing equations of fluid dynamics – Continuity, Momentum and Energy Equation, Incompressible Inviscid flows sources, Vortex flow model.

UNIT-II:

FINITE DIFFERENCE TECHNIQUES IN FLUID FLOW: Transformations and grids, Mac Cormack's method, finite differences, discretization, consistency, stability

UNIT-III:

FUNDAMENTALS OF FLUID FLOW MODELING: Elementary finite difference quotients, and implementation aspects of finite difference equations.

UNIT- III:

FINITE DIFFERENCE METHOD (FDM): Finite difference applications in heat conduction and convection- Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, & finite difference application in convective heat transfer.

UNIT IV:

FINITE VOLUME METHODS (FVM): Introduction of finite volume methods in computational fluid dynamics, Approximation of surface integrals, volume integrals, interpolation and differentiation practices, Cell Centered formulation,

UNIT V:

APPLICATIONS OF CFD: Turbulence Models**,** LAX Wendroff time stepping Models , Aspects of CFD computations with commercial Software, Aerospace, Marine & Automotive applications .

TEXT BOOKS:

1. Computational Fluid Dynamics: An Introduction, John F. Wendt, John David Anderson, Springer, 2009.
2. Computational fluid flow and heat transfer, Niyogi, Pearson Publications.

REFERENCES:

1. Numerical Heat Transfer and Fluid flow, S.V. Patankar, Taylor & Francis, 1980.
2. Computational Fluid Dynamics – The Basics with Applications (1-5 Chapters), John D.Anderson, Jr. McGraw – Hill, Inc., New York, 1995.
3. Muralidhar, K. Sundarajan, T., Computational Fluid Flow and Heat Transfer, Narosa Publishing House, 1995.