BAPATLA ENGINEERING COLLEGE: BAPATLA

DEPARTMENT OF MECHANICAL ENGINEERING

Revised Curriculum – R 20

Academic Regulations,

Scheme & Course structure

and

Syllabus

Bapatla Engineering College::BAPATLA

(Autonomous)
Academic Regulations
Regulations for Four Year Bachelor of Technology (B.Tech) Degree programme for the Batches admitted from the academic year 2020-21

B.Tech Regular Four Year Degree Programme
(Academic Regulations as amended in November 2021)

Preliminary Definitions and Nomenclature AICTE: Means All India Council for Technical Education, New Delhi.

Autonomous Institute: Means an institute designated as Autonomous by University Grants Commission (UGC), New Delhi in concurrence with affiliating University (Acharya Nagarjuna University, Guntur).

Academic Autonomy: Means freedom to an institute in all aspects of conducting its academic programs, granted by UGC for Promoting Excellence.

Academic Council: The Academic Council is the highest academic body of the institute and is responsible for the maintenance of standards of instruction, education and examination within the institute. Academic Council is an authority as per UGC regulations and it has the right to take decisions on all academic matters including academic research.

Academic Year: It is the period necessary to complete an actual course of study within a year. It comprises two main semesters i.e., one odd and one even.

Branch: Means specialization in a program like B.Tech degree program in Civil Engineering, B.Tech degree program in Computer Science and Engineering etc.

Board of Studies (BOS): BOS is an authority as defined in UGC regulations, constituted by Head of the Organization for each of the departments separately. They are responsible for curriculum design and updation in respect of all the programs offered by a department.

Backlog Course: A course is considered to be a backlog course, if the student has obtained a failure grade in that course.

Basic Sciences: The courses offered in the areas of Mathematics, Physics, Chemistry etc., are considered to be foundational in nature.

Commission: Means University Grants Commission (UGC), New Delhi.

Choice Based Credit System: The credit-based semester system is one which provides flexibility in designing curriculum and assigning credits based on the course content and hours of teaching along with provision of choice for the student in the course selection.

Certificate Course: It is a course that makes a student to have hands-on expertise and skills required for holistic development in a specific area/field.

Compulsory course: Course required to be undertaken for the award of the degree as per the program.

Internal Examination: It is an examination conducted towards sessional assessment.

Core: The courses that are essential constituents of each engineering discipline are categorized as professional core courses for that discipline.

Course: A course is a subject offered by a department for learning in a particular semester.

Course Outcomes: The essential skills that need to be acquired by every student through a course.

Credit: A credit is a unit that gives weight to the value, level or time requirements of an academic course. The number of 'Contact Hours' in a week of a particular course determines its credit value. One credit is equivalent to one lecture/tutorial hour per week.

Credit point: It is the product of grade point and number of credits for a course.

Cumulative Grade Point Average (CGPA): It is a measure of cumulative performance of a student overall the completed semesters. The CGPA is the ratio of total credit points secured by a student in various courses in all semesters and the sum of the total credits of all courses in all the semesters. It is expressed up to two decimal places.

Curriculum: Curriculum incorporates the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of Program Educational Objectives.

Department: An academic entity that conducts relevant curricular and co-curricular activities, involving both teaching and non-teaching staff, and other resources in the process of study for a degree.

Detention in a Course: Student who does not obtain minimum prescribed attendance in a course shall be detained in that particular course.

Elective Course: A course that can be chosen from a set of courses. An elective can be Professional Elective and/or Open Elective.

Evaluation: Evaluation is the process of judging the academic performance of the student in her/his courses. It is done through a combination of continuous internal examinations and semester end examinations.

Grade: It is an index of the performance of the students in a said course. Grades are indicated by alphabets.

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

Institute: Means Bapatla Engineering College, Bapatla, unless indicated otherwise by the context.
Massive Open Online Courses (MOOC): MOOCs inculcate the habit of self-learning. MOOCs would be additional choices in all the elective group courses.

Minor: Minors are coherent sequences of courses which may be taken in addition to the courses required for the B.Tech degree.

Pre-requisite: A specific course or subject, the knowledge of which is required to complete before student register another course at the next grade level.

Professional Elective: It indicates a course that is discipline centric. An appropriate choice of minimum number of such electives as specified in the program will lead to a degree with specialization.

Program: Means, UG degree program: Bachelor of Technology (B.Tech).

Program Educational Objectives: The broad career, professional and personal goals that every student will achieve through a strategic and sequential action plan.

Project work: It is a design or research-based work to be taken up by a student during his/her final year to achieve a particular aim. It is a credit-based course and is to be planned carefully by the student.

Registration: Process of enrolling into a set of courses in a semester of a program.

Regulations: The regulations, common to all B.Tech programs offered by Institute, are designated as "BEC Regulations – R20" and are binding on all the stakeholders.

Semester: It is a period of study consisting of 16 to 18 weeks of academic work equivalent to normally 90 working days. Odd semester commences usually in July and even semester in December of every year.

Semester End Examinations: It is an examination conducted for all courses offered in a semester at the end of the semester.

Student Outcomes: The essential skill sets that need to be acquired by every student during her/his program of study. These skill sets are in the areas of employability, entrepreneurial, social and behavioural.

University: Means Acharya Nagarjuna University, Guntur.

1. Award of B.Tech. Degree

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

i. Pursues a course of study for not less than four academic years and in not more than eight academic years. However, for the students availing Gap year facility, this period shall be extended by two years at the most and these two years would not be counted in the maximum time permitted for graduation. A lateral entry student pursues a course of study for not less than three academic years and in not more than six academic years

ii. Registers for 160 credits and secures all 160 credits. However, a lateral entry student registers for 121 credits and secures all the 121 credits from III semester to VIII semester of Regular B. Tech. program.

iii. The student will be eligible to get Under graduate degree with honours or additional minor engineering if he/she completes an additional 20 credits

iv. A student will be permitted to register either for Honours degree or additional minor engineering but not both.

2. Students, who fail to fulfil all the academic requirements for the award of the degree within eight academic years from the year of their admission, shall forfeit their seat in B.Tech. course and their admission stands cancelled. A lateral entry student should complete the course within six academic years from the year of their admission, failing which his/her admission in B.Tech course stands cancelled

3. Courses of study

The following courses of study are offered at present as specializations for the B. Tech. course

S.No.	Title of the UG Programme	Abbreviation
1.	Civil Engineering	CE
2.	Computer Science & Engineering	CS
3.	Electrical & Electronics Engineering	EE
4.	Electronics & Communication Engineering	EC
5.	Electronics & Instrumentation Engineering	EI
6.	Information Technology	IT
7.	Mechanical Engineering	ME
8.	Cyber Security	CB
9.	Data Science	DS

4. Credits:

i. *Credit:* A unit by which the course work is measured. It determines the number of hours of instructions required per week. One credit is equivalent to one hour of teaching (Lecture) or two hours of practical work/field work per week.
ii. *Academic Year:* Two consecutive (one odd + one even) semesters constitute one academic year.
iii. *Choice Based Credit System (CBCS):* The CBCS provides choice for students to select from the prescribed courses.
iv. Each course in a semester is assigned certain number of credits based on following

Description	Periods/Week	Credits
Theory	03	03
Tutorial	01	01
Practical	03	1.5
Internship (At the end of IV & VI evaluated in V & VII resp.)	-	1.5/3.0
Project Work	-	12

5. Course Structure

Every course of the B.Tech program will be placed in one of the 8 categories with suggested credits as listed below.

S.No.	Category	Category Description	Abbreviated Category	Credits
1	Humanities and social science	Humanities and social science including Management courses	HS	10.5
2	Basic Sciences	Basic Science courses	BS	21
3	Engineering Science courses	Engineering Science Courses including workshop, drawing, basics of electrical / mechanical / computer etc.	ES	24
4	Professional core	Professional core Courses	PC	51
5	Open Electives	Open Elective Courses- from other technical/ emerging and job oriented	OE	12
6	Professional Courses	Professional Elective Courses relevant to chosen specialization/ branch	PE	18
7	Project Work	Project Work, Seminar, Internship in industry elsewhere	PW	16.5
8	Mandatory courses	Environmental Studies, Induction training, Universal human Values, Ethics, Indian Constitution, Essence of Indian Traditional Knowledge (Non-Credit)	MC	0
9	Skill Oriented	Skill Oriented Courses relevant	SC	10

	Courses	to domain, interdisciplinary, communication skill, industry		
		Total Credits		160

6. Weightage for course evaluation

6.1 Course Pattern

- The entire course of study is for four academic years. Semester pattern shall be followed in all years.
- A student eligible to appear for the end examination in a subject, but absent or has failed in the end examination may appear for that subject at the next supplementary examination when offered.
- When a student is detained due to lack of credits/shortage of attendance he/she may be re-admitted when the semester is offered after fulfilment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

6.2 Evaluation Process

The performance of the students in each semester shall be assessed course wise. All assessments will be done on absolute mark basis. However, for the purpose of reporting the performance of a candidate, letter grades and grade points will be awarded.

The performance of a student in each course is assessed with alternate assessment methods, term examinations on a continuous basis during the semester called Continuous Internal Evaluation (CIE) and a Semester End Examination (SEE) conducted at the end of the semester. For each theory, design and/or drawing course, there shall be a comprehensive Semester End Examination (SEE) of three hours duration at the end of each Semester, except where stated otherwise in the detailed Scheme of Instruction.

The performance of a student in each semester shall be evaluated subject wise with a maximum of 100 marks for theory and 100 marks for practical subject. In addition, Internships carried out after IV Semester & VI Semester shall be evaluated for 100 marks each and the Internship along with Project Work carried out in VIII Semester shall be evaluated for 150 marks. For theory subjects, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End-Examination. For practical subjects, the distribution shall be 30 marks for Internal Evaluation and 70 marks for the End- Examination. For project work, the distribution shall be 50 marks for Internal Evaluation and 100 marks for the End-Examination / Viva-Voce. The distribution of marks between Continuous Internal Evaluation (CIE) and Semester End Examination (SEE) to be conducted at the end of the semester will be as follows:

Nature of the Course	**CIE**	**SEE**
Theory subjects	30	70
Drawing	30	70
Practical	30	70
Summer / Industrial / Research Internship	--	100

Project work	50	100

6.3 Continuous Internal Evaluation (CIE) in Theory subjects:

6.3.1 In each Semester there shall be two Term examinations and some ***Alternate Assessment Tools (AAT)*** like Home Assignment, Class Test, Problem Solving, Group Discussion, Quiz, Seminar and Field Study in every theory course. The Alternate Assessment Tools with detailed modality of evaluation for each course shall be finalized by the teacher concerned before beginning of the course. It will be reviewed and approved by the Department Committee.

The Term Examination is conducted in the regular mode according to a schedule which will be common for a particular year of study. The maximum weightage for Term Examinations, AATs and the calculation of marks for CIE in a theory course is given in the following table.

Particulars	**Term Exams (Max. 20 marks)**	**AAT (Max. 10 marks)**
Better Performed exam	75% of marks obtained	Continuous assessment by teacher as per the predetermined course delivery & assessment plan. (Minimum two & maximum four assessments). AAT marks shall be considered based on average of all tests conducted.
Other exam	25% of marks obtained	

A minimum of 15 (50%) marks are to be secured exclusively in the Continuous Internal Evaluation (CIE) in order to be declared as qualified in that course and eligible to write the SEE of that course. If a student fails to obtain 15 marks in CIE, he can register for the course repetition as per the guidelines mentioned in 6.5.

6.3.2 Semester End Examination (SEE) in Theory and Design Course:

a) For each theory, design and/or drawing course, there shall be a comprehensive Semester End Examination (SEE) of three hours duration at the end of each Semester for 70 marks, except where stated otherwise in the detailed Scheme of Instruction. Question paper setting shall be set by the teacher or teachers together in a multi section courses and to be verified as described in policy document.

b) A minimum of 25 (Approx. 35%) marks are to be secured exclusively in the Semester End Examination (SEE) of theory, design and/or drawing course. However a minimum 40 marks are to be secured in CIE & SEE together for the award of the grade and securing the credits in that course.

6.3.3 Continuous Internal Evaluation (CIE) in laboratory courses:

The evaluation for Laboratory course is based on CIE and SEE. The CIE for 30 marks comprises of 15 marks for day to day laboratory work, 5 marks for record submission and 10 marks for a laboratory examination at the end of the semester. In any semester, a minimum of 90% of prescribed number of experiments / exercises specified in the syllabi for laboratory course shall be taken up by the students. They shall complete these experiments / exercises in all respects and get the record certified by the internal lab teacher concerned and the Head of the Department concerned to be eligible to appear for the Final Examination in that laboratory course.

A minimum of 15 (50%) marks are to be secured exclusively in the Continuous Internal Evaluation (CIE) in order to be declared as qualified in that lab course and eligible to write the SEE of that lab course. If a student fails to obtain 15 marks in CIE, he can register for the course repetition as per the guidelines mentioned in 6.5.

6.3.4 Semester End Examination (SEE) in laboratory courses:

a) For each laboratory course, the Semester End Examination (SEE) shall be conducted by one internal and one external examiner appointed by the Principal and the duration of the exam shall be for three hours. The SEE is for 70 marks which include 15 marks for write up, 35 marks for lab experiment/exercise, 15 marks for Viva-voce and 5 marks for general impression.

b) A minimum of 25 (Approx. 35%) marks are to be secured exclusively in the Semester End Examination (SEE) of laboratory course. However a minimum 40 marks are to be secured in CIE & SEE together for the award of the grade and securing the credits in that course.

6.3.5 Evaluation of Summer Internship and Industrial/Research Internship:

a) **Summer Internship at the end of IV semester and Industrial/Research Internship** at the end of VI carried out in industry are to be evaluated in V & VII semesters respectively based report and certificate provided by the industry. The report and certificate will be evaluated by the department committee for 100 marks. 50 marks shall be for the report and certificate and 50 marks based on seminars/presentation to the department committee by the student.

b) A minimum of 40 (40%) marks are to be secured exclusively to be declared as passed and securing the credits in the internships.

6.3.6 Evaluation of the Project

a) In case of the Project work, the evaluation shall be based on CIE and SEE. The CIE for 50 marks consists of a minimum of two Seminars / presentations for 20 marks and

the Project Report submitted at the end of the semester which is evaluated for 30 marks.

b) A minimum of 25 (50%) marks are to be secured exclusively in the Continuous Internal Evaluation (CIE) in order to be declared as passed in the Project Work and eligible to write the SEE in the Project Work.

c) SEE shall be evaluated in the form of a Viva- voce and the demonstration of the thesis work for 100 marks. Viva-voce Examination in Project Work shall be conducted by one internal examiner and one external examiner to be appointed by the Principal.

d) A minimum of 40 (40%) marks shall be obtained in SEE exclusively in order to be declared as passed in the Project and for the award of the grade.

NOTE : A student who is absent for any Test / Exam / Seminar / Presentation as a part of Continuous Internal Evaluation (CIE), for any reason whatsoever, shall be deemed to have scored zero marks in the respective component and no provision for make-up shall be provided.

6.4 There shall be mandatory courses with zero credits. There shall be no external examination. However, attendance in the mandatory course shall be considered while calculating aggregate attendance and student shall be declared to have passed the mandatory course only when he/she secures 50% or more in the internal examinations. In case, the student fails, a re-examination shall be conducted for failed candidates every six months/semester at a mutually convenient date of college/student satisfying the conditions mentioned in item 1 & 2 of the regulations.

6.5 Course Repetition (Repeater course)

The students not qualified to write SEE in a course may register for the repeater courses through course repetition and summer semester. The students have to apply to the Principal through the respective HOD by paying prescribed fees.

Course repetition: A student can take up a maximum of two theory courses in a semester immediately after the semester end examinations of that particular semester in accordance with the guidelines recommended by the Academic Council. The students who are not taking regular semester courses may additionally register for one more theory course.

Summer semester: Further the students can register maximum three (theory + lab courses together) courses in the summer semester. Summer semester courses shall be of both even & odd semesters. Summer semester shall be conducted immediately after completion of even semester end examinations.

The HODs concerned have to allot a teacher related to that course to conduct class work. The minimum number of periods to be conducted should not be less than 75% of the total prescribed periods for that course. The classes will be conducted in the vacation period or in the weekends or in the afternoons as decided by the HOD concerned. Teacher has to evaluate the student for his performance in CIE as per the autonomous norms and the qualified students should appear for a semester end examination. The pass criteria in both CIE & SEE should be as per autonomous norms.

The documents for monitoring the candidates registered for course repetition are available with the Heads of the Departments and Exam Section.

6.6 There shall be five Professional Elective Courses from V Semester to VII and for each elective there shall be choices such that the student shall choose a course from the list of choice courses offered by the department for that particular elective.

6.7 There shall four be Open Electives / Job Oriented Courses common to all disciplines from V Semester to VII, where in the students shall choose the electives offered by various departments including his/her own department in such a manner that he/she has not studied the same course in any form during the Programme.

The students shall be permitted to pursue up to a maximum of two elective courses (either Professional Elective Courses in clause 6.6 or Open Electives/ Job Oriented Courses in clause 6.7) under MOOCs (Massive Open Online Courses) offered by NPTEL and other reputed organizations as notified by the Department during the semester. Each of the Courses must be of minimum 8/12 weeks in duration. The student has to acquire a certificate for the concerned course from the agency during the semester only in order to earn the credits for that course.

6.8 There shall be a mandatory **induction program** for three weeks before the commencement of first semester.

6.9 **Minor in a discipline** (Minor degree/programme) concept is introduced in the curriculum for all conventional B. Tech programmes in which it offers a major. The main objective of Minor in a discipline is to provide additional learning opportunities for academically motivated students and it is an optional feature of the B. Tech. programme.

a. i) 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

   ii) 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.

b. 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.

c. The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BOS.

d. There shall be no limit on the number of programs offered under Minor. The University/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.

e. 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.

f. 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.

g. 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).

h. 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.

i. 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. If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the university/academic council.

j. Student can opt for the Industry relevant minor specialization as approved by the

concerned departmental BOS. Student 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 course completion certificate. The Board of studies 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.

k. A committee should be formed at the level of College/Universities/department to evaluate the grades/marks given by external agencies to a student which are approved by concerned BOS. 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.

l. 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.

m. In case a student fails to meet the CGPA 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.

n. 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.

o. Minimum enrollment for a Minor course to be offered is 12

p. Students fulfilling the stipulated criterion can register for a Minor by paying a prescribed registration fee.

6.10 Honors degree in a discipline:

Students of a Department/Discipline are eligible to opt for Honors Programme offered by the same Department/Discipline.

a. 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 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.

b. 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.

c. 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).

d. 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 Board of studies.

e. 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.

f. The concerned BOS 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 BOS.

g. Each pool can have theory as well as laboratory courses. 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. (Model pool list is enclosed in the Annexure-2).

h. 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 BOS with grading or marks or pass/fail in order to earn credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the BOS/academic council.

i. 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.

j. 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 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.

k. In case a student fails to meet the CGPA 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.

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

m. Minimum enrollment for the Honors to be offered is 12.

n. Students fulfilling the stipulated criterion can register for Honors by paying a prescribed registration fee.

6.11 National Service Scheme (NSS)/Yoga is compulsory for all the Undergraduate students. The student participation shall be for a minimum period of 45 hours during the first year. Grades will be awarded as Very Good, Good, Satisfactory in the mark sheet on the basis of participation, attendance, performance and behaviour. If a student gets Un-satisfactory grade, he/she has to repeat the above activity in the subsequent years along with the next year students.

6.12 Students shall undergo two summer internships each for a minimum of six weeks duration at the end of second and third years of the programme for 1.5 credits & 3 credits respectively. The organization in which the student wishes to carry out Internship need to be approved by Internal Department Committee comprising Head of Department and two senior faculty members. The student shall submit a detailed technical report along with internship certificate from the Internship organization in order to obtain the prescribed credits. The student shall submit the Internship Project Report along with Certificate of Internship. The evaluation of the first and second summer internships shall be conducted at the end of the V Semester & VII semester respectively.

There shall be internal evaluation for 100 marks and there shall not be external evaluation. The Internal Evaluation shall be made by the departmental committee (Head of the Department and two senior faculty of the department) on the basis of the project report submitted by the student.

Completion of the internship is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such a case, the student shall repeat the internship in the subsequent summer provided that the student doesn't pursue two summer internships in the same summer.

Community Service Project focussing on specific local issues shall be an alternative to the six weeks of summer Internship, whenever there is any emergency and when students cannot pursue their summer internships. The Community Service Project shall be for 6 weeks in duration which includes preliminary survey for 1 week,

community awareness programs for one week, community immersion program in consonance with Government agencies for 3 weeks and a community exit report (a detailed report) for one week. The community service project shall be evaluated for 100 marks by the internal departmental committee comprising Head of the Department and two senior faculty of the department. **However, the first priority shall be given to the internship.**

6.13 There shall also be a mandatory full internship in the final semester (VIII Semester) of the Programme along with the project work. The organization in which the student wishes to carry out the Internship need to be approved by Internal Department Committee comprising Head of the Department and two senior faculty. The faculty of the respective department monitors the student internship program along with project work. At the end of the semester, the candidate shall submit a certificate of internship and a project report. The project report and presentation shall be internally evaluated for 50 marks by the departmental committee consisting of Head of the Department, Project supervisor and a senior faculty member. The Viva-Voce shall be conducted for 100 marks by a committee consisting of HOD, Project Supervisor and an External Examiner.

Completion of internship is mandatory, if any student fails to complete internship, he/she will not be eligible for the award of degree. In such a case, the student shall repeat the internship along with project work for next six months.

6.14 There shall be five skill-oriented courses offered during III semester to VII semester. Out of the five skill courses, two shall be skill-oriented programs related to the domain and these two shall be completed in second year. Of the remaining three skill courses, one shall 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 student can choose between a skill advanced course being offered by the college or to choose a certificate course being offered by industries/Professional bodies/APSSDC or any other accredited bodies which are duly approved by the Internal Department Committee. The credits assigned to the skill advanced course shall be awarded to the student upon producing the Course Completion Certificate from the agencies / professional bodies.

The Internal Department Committee comprising Head of Department and two senior faculty shall evaluate the grades / marks awarded for a course by external agencies and convert to the equivalent marks / grades.

7. Attendance Requirements:

- A student shall be eligible to appear for semester end examinations (SEE), if he/she acquires a minimum of 75% of attendance in aggregate of all the subjects in a semester.

- Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted on medical ground duly approved by the Principal.
- Shortage of Attendance below 65% in aggregate shall in NO case be condoned.
- Further the student must obtain a minimum of 50% attendance in each subject failing which; the student shall not be permitted to write the SEE of that subject. Student has to register this subject through course repetition and satisfy the CIE qualification criteria of attendance and marks in the subsequent semesters.
- Students whose shortage of attendance is not condoned in any semester are not eligible to take their end examination of that class and their registration shall stand cancelled.
- A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester. They may seek readmission for that semester when offered next.
- A stipulated fee shall be payable towards condonation of shortage of attendance to the college.

8. Minimum Academic Requirements:

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.7

8.1 A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, practical, design, drawing subject or project, if he/she secures not less than 15 marks in CIE and 25 marks in SEE. In case of, internships, project work viva – voce, he/she should secure 40% of the total marks. For mandatory courses minimum 15 marks in CIE are to be secured.

8.2 B.Tech students: A student shall be promoted from II to III year only if he/she fulfils the academic requirement of securing 40% of the credits in the subjects that have been studied up to III Semester from the following examinations.

One regular and two supplementary examinations of I Semester.
One regular and one supplementary examination of II Semester.
One regular examination of III semester.

Lateral Entry students: A student shall be promoted from II to III year only if he/she fulfils the academic requirement of securing 40% of the credits in the subjects that have been studied up to III Semester from the following examinations.

One regular examination of III semester.

8.3 B.Tech students: A student shall be promoted from III year to IV year only if he/she fulfils the academic requirements of securing 40% of the credits in the subjects that have been studied up to V semester from the following examinations, irrespective of whether the candidate takes the end examination or not as per the normal course of study.

One regular and four supplementary examinations of I Semester.

One regular and three supplementary examinations of II Semester.
One regular and two supplementary examinations of III Semester.
One regular and one supplementary examinations of IV Semester.
One regular examination of V Semester.

Lateral entry students: A student shall be promoted from III year to IV year only if he/she fulfils the academic requirements of securing 40% of the credits in the subjects that have been studied up to V semester from the following examinations, irrespective of whether the candidate takes the end examination or not as per the normal course of study.

One regular and two supplementary examinations of III Semester.
One regular and one supplementary examinations of IV Semester.
One regular examination of V Semester.

And if a student is detained for want of credits for particular academic year by sections 8.2 and 8.3 above, the student may make up the credits through supplementary examinations and only after securing the required credits he/she shall be permitted to join in the V Semester or VII Semester as the case may be.

8.4 A student shall register and put up minimum attendance in all 160 credits and earn all the 160 credits. Marks obtained in all 160 credits shall be considered for the calculation of aggregate percentage of marks obtained. In case of lateral entry students, the number of credits is 121.

8.5 Students who fail to earn 160 credits as indicated in the course structure within eight academic years from the year of their admission shall forfeit their seat in B.Tech. course and their admission shall stand cancelled.

Lateral entry students who fail to earn 121 credits as indicated in the course structure within six academic years from the year of their admission shall forfeit their seat in B.Tech. course and their admission shall stand cancelled.

9. Course Pattern:

(i) A student eligible to appear for the end examination in a subject, but absent or has failed in the end examination may appear for that subject at the next supplementary examination when offered.

When a student is detained due to lack of credits/shortage of attendance he/she may be re-admitted when the semester is offered after fulfilment of academic regulations. In such case, he/she shall be in the academic regulations into which he/she is readmitted.

(ii) **With–holding of Results**

If any case of indiscipline or malpractice is pending against candidate, the result of the candidate shall be with held and he/she will not be allowed/promoted into the next higher semester. The issue of awarding degree is liable to be withheld in such cases.

(iii) **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.

Table – Conversion into Grades and Grade Points assigned

Range in which the marks in the subject fall	Grade	Grade Points Assigned
≥ 90	S (Superior)	10
80-89	A (Excellent)	9
70-79	B (Very Good)	8
60-69	C (Good)	7
50-59	D (Average)	6
40-49	E (Below Average)	4
< 40	F (Fail)	0
Absent	Ab (Absent)	0

A student obtaining Grade F shall be considered failed and will be required to reappear for that subject when the next supplementary examination offered. Same is the case with a student who obtains 'Ab' in end examination.

For **mandatory** courses "Satisfactory" or "Unsatisfactory" shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

10. 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.,

$$\text{SGPA} = \frac{\sum_{i=1}^{n} C_i \times GP_i}{\sum_{i=1}^{n} C_i}$$

where, C_i is the number of credits of the i^{th} subject and GP_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.,

$$\text{CGPA} = \frac{\sum_{j=1}^{m} SGPA_j \times TC_j}{\sum_{j=1}^{m} TC_j}$$

where "$SGPA_j$" is the SGPA of the j^{th} semester and TC_j 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) While computing the SGPA, the subjects in which the student is awarded Zero grade points will also be included.

(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 S, A, B, C, D, E and F.

11. 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 four classes.

Class Awarded	**CGPA Secured**
First Class with Distinction	≥ 7.5
First Class	≥ 6.5 < 7.5
Second Class	≥ 5.5 < 6.5
Pass Class	≥ 4.0 < 5.5

12. 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 II year to pursue entrepreneurship full time. This period may be extended to two years at the most and these two years would not be

counted for the time for the maximum time for graduation. An evaluation committee shall be constituted by the College to evaluate the proposal submitted by the student and the committee shall decide whether or not to permit the student(s) to avail the Gap Year.

13. Transitory Regulations

Discontinued, detained, or failed candidates are eligible for readmission as and when the semester is offered after fulfilment of academic regulations. Candidates who have been detained for want of attendance or not fulfilled academic requirements or who have failed after having undergone the course in earlier regulations or have discontinued and wish to continue the course are eligible for admission into the unfinished semester from the date of commencement of class work with the same or equivalent subjects as and when subjects are offered, and they will be in the academic regulations into which they get readmitted.

Candidates who were permitted with Gap Year shall be eligible for rejoining into the succeeding year of their B.Tech from the date of commencement of class work, and they will be in the academic regulations into which the candidate is presently re-joining.

14. Minimum Instruction Days

The minimum instruction days including exams for each semester shall be 90 days.

15. Medium of Instruction

The Medium of Instruction is **English** for all courses, laboratories, internal and external examinations and project reports.

16. Rules of Discipline

(i) Use of mobile phones with camera, in the campus is strictly prohibited.
(ii) Students shall behave and conduct themselves in a dignified and courteous manner in the campus/Hostels.
(iii) Students shall not bring outsiders to the institution or hostels.
(iv) Students shall not steal, deface, damage or cause any loss to the institution property.
(v) Students shall not collect money either by request or coercion from others within the campus or hostels.
(vi) Students shall not resort to plagiarism of any nature/extent. Use of material, ideas, figures, code or data without appropriate acknowledgement or permission of the original source shall be treated as cases of plagiarism. Submission of material, verbatim or paraphrased, that is authored by another person or published earlier by oneself shall also be considered as cases of plagiarism.
(vii) Use of vehicles by the students inside the campus is prohibited.

(viii) Any conduct which leads to lowering of the esteem of the organization is prohibited.

(ix) Any material to be uploaded to social media sites need to be approved by Head of the Department concerned/Dean/Principal.

(x) Any student exhibiting prohibited behaviour shall be suspended from the institute. The period of suspension and punishment shall be clearly communicated to the student. The student shall lose the attendance for the suspended period

(xi) Dress Code

Boys : All the boy students should wear formal dresses. Wearing T-shirts and other informal dresses in the campus is strictly prohibited.

Girls : All the girls students shall wear saree / chudidhar with dupatta

17. Punishments for Malpractice cases – Guidelines

The examinations committee may take the following guidelines into consideration while dealing with the suspected cases of malpractice reported by the invigilators/squad members etc; during end examinations. The punishment may be more severe or less severe depending on the merits of the individual cases.

S.No.	Nature of Malpractice/Improper conduct	Punishment
1	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cellphones, pager, palm computers or any other form of material concerned with or related to the course of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the course of the examination).	Expulsion from the examination hall and cancellation of the performance in that course only.
2	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that course.
3	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that course and all other courses the candidate has appeared including practical examinations and project work of that semester/year examinations.
4	Gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell	Expulsion from the examination hall and cancellation of the performance in that course only of all the students involved. In case of an outsider, he will be handed over to

	phones with any other student or persons in or outside the exam hall in respect of any matter.	the police and a case shall be registered against him.
5	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the course of the examination (theory or practical) in which the student is appearing.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses including practical examinations and project work of that semester/year.
6	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses including practical examinations and project work of that semester/year.
7	Smuggles in the Answer book or takes out or arranges to send out the question paper during the examination or answer book during or after the examination	Expulsion from the examination hall and cancellation of performance in that course and all the other courses including practical examinations and project work of that semester/year. The student is also debarred for two consecutive semesters from class work and all examinations. The continuation of the course by the student is subject to the academic regulations in connection with forfeit of seat.
8	Refuses to obey the orders of the Chief 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 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	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that course and all other courses of that semester/year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case shall be registered against them.

	or misconduct or has the tendency to disrupt the orderly conduct of the examination.	
9	Leaves the exam hall taking away answer script or intentionally tears up the script or any part there of inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that course and all the other courses including practical examinations and project work of that semester/year. The candidate is also debarred for two consecutive semesters from classwork and all end examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
10	Possesses any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that course and all other courses including practical examinations and project work of that semester/year. The student is also debarred and forfeits the seat.
11	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in S.No7 to S.No 9.	For Student of the college: Expulsion from the examination hall and cancellation of the performance in that course and all other courses including practical examinations and project work 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 shall be registered against them.
12	Impersonates any other student in connection with the examination	The student who has impersonated shall be expelled from examination hall. The student is debarred from writing the remaining exams, and rusticated from the college for one academic year during which period the student will not be permitted to write any exam. If the imposter is an outsider, he will be handed over to the police and a case shall be registered against him. The performance of the original student who has been impersonated, shall be cancelled in all the courses of the examination including practicals and project work of that semester/year. The student is rusticated from the college for two consecutive years during which period the student will not be permitted to write any exam. The continuation of the course by the student is subject to the academic regulations in connection with forfeiture of seat.

13	If any malpractice is detected which is not covered in the above S.No 1 to S.No 12 items, it shall be reported to the college academic council for further action and award suitable punishment.
14	Malpractice cases identified during sessional examinations will be reported to the examination committee nominated by Academic council to award suitable punishment.

18.0 ADDITIONAL ACADEMIC REGULATIONS:

18.1 Any attempt to impress upon the teachers, examiners, faculty and staff of Examinations, bribing for either marks or attendance will be treated as malpractice.

18.2 When a component of Continuous Internal Evaluation (CIE) or Semester End Examination (SEE) is cancelled as a penalty, he/she is awarded zero marks in that component.

19.0 AMENDMENTS TO REGULATIONS:

The Academic Council of Bapatla Engineering College (Autonomous) reserves the right to revise, amend, change or nullify the Regulations, Schemes of Examinations and / or Syllabi, Academic schedules, Examination schedules, Examination pattern, Moderation to students, Special opportunity to complete degree beyond stipulated time and any other matter pertained that meets to the needs of the students, society and industry without any notice and the decision is final.

BAPATLA ENGINEERING COLLEGE: BAPATLA

(Autonomous)

SCHEME OF INSTRUCTION & EXAMINATION (Semester System)

For

Mechanical Engineering

Effective from the Academic Year2020-2021 (R20 Regulations)

First Year B.Tech (SEMESTER – I)

Code No.	Subject	Scheme of Instruction (Hours per week)				Scheme of Examination (Maximum marks)			No. of Credits
		L	T	P	Total	CIE	SEE	Total Marks	
20ME101/MA01	Mathematics-I (Linear Algebra and Ordinary Differential Equations)	3	0	0	3	30	70	100	3
20ME102/PH01	Physics (Advanced Optics and Material Testing)	3	0	0	3	30	70	100	3
20ME103/EE01	Basic Electrical and Electronics Engineering	3	0	0	3	30	70	100	3
20ME104	Engineering Mechanics-I	3	0	0	3	30	70	100	3
20ME105/CS01	Problem Solving using Programming	3	0	0	3	30	70	100	3
20MEL101/PHL01	Physics Laboratory	0	0	3	3	30	70	100	1.5
20MEL102/EEL01	Basic Electrical and Electronics Engineering Lab	0	0	3	3	30	70	100	1.5
20MEL103/CPL01	Problem Solving Using Programming lab	0	0	3	3	30	70	100	1.5
Induction Program	First Three Weeks (Physical activity, Creative Arts,Universal Human Values, Literary, Proficiency Modules, Lectures by Eminent People, Familiarization to Dept./Branch & Innovations)								
	TOTAL	**15**	**0**	**9**	**24**	**240**	**400**	**800**	**19.5**

CIE: Continuous Internal Evaluation SEE: Semester End Examination

L: Lecture, T: Tutorial, P: Practical

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

BAPATLA ENGINEERING COLLEGE: BAPATLA

(Autonomous)

SCHEME OF INSTRUCTION & EXAMINATION (Semester System)

For

Mechanical Engineering

Effective from the Academic Year2020-2021 (R20 Regulations)

First Year B.Tech (SEMESTER – II)

Code No.	Subject	Scheme of Instruction (Hours per week)				Scheme of Examination (Maximum marks)			No. of Credits
		L	T	P	Total	CIE	SEE	Total Marks	
20ME201/MA02	Mathematics-II (Numerical Methods and Advanced Calculus)	3	0	0	3	30	70	100	3
20ME202/CY01	Engineering Chemistry	3	0	0	3	30	70	100	3
20ME203/EL01	Communicative English	3	0	0	3	30	70	100	3
20ME204	Engineering Mechanics- II	3	0	0	3	30	70	100	3
20ME205/CE01	Environmental Studies	2	0	0	2	30	--	30	0
20MEL201/MEL01	Engineering Graphics	1	0	4	5	30	70	100	3
20MEL202/CYL01	Engineering Chemistry Laboratory	0	0	3	3	30	70	100	1.5
20MEL203/ELL01	English Communication Skills Laboratory	0	0	3	3	30	70	100	1.5
20MEL204/MEL02	Workshop Practice Lab	0	0	3	3	30	70	100	1.5
	NCC/NSS	0	0	2	2	--	--	--	0
	TOTAL	15	0	15	30	450	450	830	19.5

CIE: Continuous Internal Evaluation SEE: Semester End Examination

L: Lecture, T: Tutorial, P: Practical

MC: Mandatory course

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

BAPATLA ENGINEERING COLLEGE: BAPATLA

(Autonomous)

PROPOSED SCHEME OF INSTRUCTION

For

Mechanical Engineering

(R20 Regulations)

Second Year B.Tech(SEMESTER – III)

Code No.	Category Code	Subject	Scheme of Instruction (Hours per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20ME301/MA03	BS	Mathematics- III	3	0	0	3	30	70	100	3
20ME302	PC	Basic manufacturing processes	3	0	0	3	30	70	100	3
20ME303	PC	Strength of Materials	3	0	0	3	30	70	100	3
20ME304/ES	ES	Engineering Thermodynamics	3	0	0	3	30	70	100	3
20ME305	PC	Fluid Mechanics &Hydraulic Machines	3	0	0	3	30	70	100	3
20MEL301	PC	Machine Drawing lab	0	0	3	3	30	70	100	1.5
20MEL302	PC	SM&FM lab	0	0	3	3	30	70	100	1.5
20MEL303	PC	Basic Manufacturing Processes lab	0	0	3	3	30	70	100	1.5
20ME306/SO	SO	Pneumatic & Hydraulic drives Lab	0	1	2	3	30	70	100	2
20ME307/MC	MC	Professional Ethics and Human Values	2	0	0	2	30	0	30	0
		TOTAL	17	1	11	29	300	630	930	21.5

CIE: Continuous Internal Evaluation SEE: Semester End Examination

L: Lecture, T: Tutorial, P: Practical

ES- Engineering Science SO- Skill Oriented MC: Mandatory course

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

BAPATLA ENGINEERING COLLEGE: BAPATLA
(Autonomous)
PROPOSED SCHEME OF INSTRUCTION
For
Mechanical Engineering
(R20 Regulations)
Second Year B.Tech (SEMESTER – IV)

Code No.	Category Code	Subject	Scheme of Instruction (Hours per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20ME401/BS	BS	Materials Engineering	3	0	0	3	30	70	100	3
20ME402	PC	Metal Cutting & Machine Tools	3	0	0	3	30	70	100	3
20ME403	PC	Kinematics of Machines	3	0	0	3	30	70	100	3
20ME404	PC	Applied Thermodynamics	3	0	0	3	30	70	100	3
20ME405/HS	HS	Industrial Engineering & Management	3	0	0	3	30	70	100	3
20MEL401	PC	Modeling lab	0	0	3	3	30	70	100	1.5
20MEL402	PC	Fuels & Oil testing lab	0	0	3	3	30	70	100	1.5
20MEL403	PC	Machine shop Practice	0	0	3	3	30	70	100	1.5
20ME406/SO	SO	Sensorics & PLC LAB	0	1	2	3	30	70	100	2
TOTAL			15	1	11	27	270	630	900	21.5
Honors/Minors course (pool-I)			**3**	**1**	**0**	**4**	**30**	**70**	**100**	**4**
Grand Total			**18**	**2**	**11**	**31**	**300**	**700**	**1000**	**25.5**

ES- Engineering Science SO- Skill Oriented HS- Humanities and Social Sciences

CIE: Continuous Internal Evaluation SEE: Semester End Examination
L: Lecture, T: Tutorial, P: Practical

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

BAPATLA ENGINEERING COLLEGE: BAPATLA
(Autonomous)
PROPOSED SCHEME OF INSTRUCTION
For
Mechanical Engineering
(R20 Regulations)
Second Year B.Tech (SEMESTER – V)

Code No.	Category Code	Subject	Scheme of Instruction (Hours per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20ME501	PC	Dynamics of Machines	3	0	0	3	30	70	100	3
20ME502	PC	Design of Machine Elements	3	0	0	3	30	70	100	3
20ME503	PC	Manufacturing Technology	3	0	0	3	30	70	100	3
20ME504-PE	PE- I		3	0	0	3	30	70	100	3
20ME505-JO	OE/JO		3	0	0	3	30	70	100	3
20MEL501	PC	IC Engines lab	0	0	3	3	30	70	100	1.5
20MEL502	PC	Design and Metrology lab	0	0	3	3	30	70	100	1.5
20ME506/ SO	SO	Internet of Things	0	1	2	3	30	70	100	2
20ME507/ MC	MC	Design Thinking & Product Innovation	2	0	0	2	30	0	30	0
20MEL503/ INT	INT	Summer Internship	0	0	0	0	0	0	0	1.5
		TOTAL	17	1	8	26	270	560	830	21.5
Honors/Minors course (pool-II)			**3**	**1**	**0**	**4**	**30**	**70**	**100**	**4**
Grand Total			**20**	**2**	**8**	**30**	**300**	**630**	**930**	**25.5**

Professional Elective-I

1. Advanced Strength of Materials
2. Non-Destructive Evaluation
3. I.C. Engines & Gas Turbines
4. Nano Technology

BAPATLA ENGINEERING COLLEGE: BAPATLA
(Autonomous)
PROPOSED SCHEME OF INSTRUCTION
For
Mechanical Engineering
(R20 Regulations)
Second Year B.Tech (SEMESTER – VI)

Code No.	Category Code	Subject	Scheme of Instruction (Hours per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20ME601	PC	CAD/CAM	3	0	0	3	30	70	100	3
20ME602	PC	Design of Transmission Elements	3	0	0	3	30	70	100	3
20ME603	PC	Heat Transfer	3	0	0	3	30	70	100	3
20ME604-PE	PE -II		3	0	0	3	30	70	100	3
20ME605-JO	JO		3	0	0	3	30	70	100	3
20MEL601	PC	Heat Transfer lab	0	0	3	3	30	70	100	1.5
20MEL602	PC	CAE lab	0	0	3	3	30	70	100	1.5
20MEL603	PC	CAM lab	0	0	3	3	30	70	100	1.5
20ME606/SS	SS	Soft Skills	0	0	3	3	30	70	100	2
20ME607/MC	MC	Constitution of India	2	0	0	2	30	0	0	0
		TOTAL	17	0	12	29	300	630	930	21.5
Honors/Minors course (pool-III)			**3**	**1**	**0**	**4**	**30**	**70**	**100**	**4**
Grand Total			**20**	**1**	**8**	**33**	**330**	**700**	**1030**	**25.5**

Professional Elective-II

1. Finite Element Analysis
2. Non-Conventional Energy Sources
3. Advanced Manufacturing Processes
4. Operations Research

BAPATLA ENGINEERING COLLEGE: BAPATLA
(Autonomous)
PROPOSED SCHEME OF INSTRUCTION
For
Mechanical Engineering
(R20 Regulations)
Second Year B.Tech (SEMESTER – VII)

Code No.	Category Code	Subject	Scheme of Instruction (Hours per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20ME701-PE	PE-III		3	0	0	3	30	70	100	3
20ME702-PE	PE-IV		3	0	0	3	30	70	100	3
20ME703-PE	PE-V		3	0	0	3	30	70	100	3
20ME704-JO	JO		3	0	0	3	30	70	100	3
20ME705-OE	OE		3	0	0	3	30	70	100	3
20ME706-HSE	HSE		2	0	2	4	30	70	100	3
20ME707/SA	SA	3D Printing	0	1	2	3	30	70	100	2
20MEL701/ INT	INT	Summer Internship	0	0	0	0	0	0	0	3
TOTAL			17	1	04	22	210	490	700	23
Honors/Minors course (pool-IV)			**3**	**1**	**0**	**4**	**30**	**70**	**100**	**4**
Grand Total			**20**	**2**	**4**	**26**	**240**	**560**	**800**	**27**

Professional Elective-III **20ME701-PE**	**Professional Elective-IV** **20ME702-PE**	**Professional Elective-V** **20ME703-PE**	**Humanities and Social Sciences Elective** **20ME706-HSE**
1. Mechanical Vibrations 2. Energy Conservation and Management 3. Robotics 4. Farm Machinery and Equipment	1. Computational Fluid Dynamics 2. Automobile Engineering 3. Composite Materials 4.Mechatronics	1. Refrigeration &Air Conditioning. 2.Computer Integrated Manufacturing 3. Operations Management 4. Product Design and Development	1.Engineering Economics & Financial Analysis 2. Entrepreneurship Development 3. Supply chain Management 4. Total Quality Management

BAPATLA ENGINEERING COLLEGE: BAPATLA

(Autonomous)

SCHEME OF INSTRUCTION & EXAMINATION (Semester System)

For

Mechanical Engineering

(R20 Regulations)

Second Year B.Tech(SEMESTER – VIII)

Code No.	Category Code	Subject	Scheme of Instruction (Hours per week)				Scheme of Examination (Maximum marks)			No. of Credits
			L	T	P	Total	CIE	SEE	Total Marks	
20MEL801	PROJ	Project Work	0	0	0	0	50	100	150	12
Honors/Minors course (MOOCs-1)			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Honors/Minors course (MOOCs-2)			**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**
Grand Total			**0**	**0**	**0**	**0**	**50**	**100**	**150**	**16**

*Students can complete Project work @ Industries/ Higher Learning Institutions/ APSSDC.

* Students has to Select 12 week MOOC's (NPTEL/Swayam) Program in opting the Programme Course Electives, for a maximum of two MOOC's (NPTEL/Swayam) Program's out of five Programme Course Electives.

LIST OF JOB ORIENTED COURSES

S.No.	SUBJECT	L	T	P	Credits
1	Java Programming	2	0	2	3
2	Database Management	2	0	2	3
3	Introduction to Data Analytics	2	0	2	3
4	Python Programming	2	0	2	3
5	Inspection and quality Control	2	0	2	3
6	Supply chain analysis	2	0	2	3
7	Industrial safety Engineering	2	0	2	3
8	Industry 4.0	2	0	2	3

List of Open Electives offered by Mechanical Engineering

S.NO.	SUBJECT	L	T	P	Credits
1	Automobile Engineering	4	0	0	4
2	Project Management	4	0	0	4
3	Entrepreneurship Development	4	0	0	4
4	Non-conventional energy sources	4	0	0	4
5	Product Design & Development	4	0	0	4

List of Honors courses

S.No.	SUBJECT	L	T	P	Credits
1	Advanced Strength of Materials	4	0	0	4
2	Non-Destructive Evaluation	4	0	0	4
3	Analysis and Synthesis of Mechanisms	4	0	0	4
4	Nano Technology	4	0	0	4
5	Finite Element Analysis	4	0	0	4
6	Advanced Manufacturing Processes	4	0	0	4
7	Design of Heat Transfer Equipment	4	0	0	4
8	Vibration and Noise Control	4	0	0	4
9	Energy Conservation and Management	4	0	0	4
10	Computational Fluid Dynamics	4	0	0	4
11	Composite Materials	4	0	0	4
12	Computer Integrated Manufacturing	4	0	0	4
13	Product Design and Development	4	0	0	4
14	Entrepreneurship Development	4	0	0	4
15	Supply chain Management	4	0	0	4
16	Total Quality Management	4	0	0	4

*For obtaining Honors/Minors, the students has to complete two MOOC's (NPTEL/Swayam) Programs of eight weeks each, in-addition to the four courses scheduled in the course structure, not exceeding two courses (One for Honor and One for Minor) in a semester.

MINOR COURSES OFFERED BY MECHANICAL ENGINEERING

S.No.	SUBJECT	L	T	P	Credits
1	Elements of Mechanical Engineering	4	0	0	4
2	Engineering Mechanics	4	0	0	4
3	Engineering economics and financial analysis	4	0	0	4
4	3D printing	4	0	0	4
5	Mechatronics	4	0	0	4
6	Entrepreneurship development	4	0	0	4
7	Automobile Engineering	4	0	0	4
8	Thermal engineering	4	0	0	4
9	Non conventional energy sources	4	0	0	4
10	Robotics	4	0	0	4
11	Manufacturing Science	4	0	0	4
12	Fundamentals of Mechanical Design	4	0	0	4

MATHEMATICS-I
(Linear Algebra and Ordinary Differential Equations)
20ME101/MA01
Ist Year B. Tech. First Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To learn about solving a system of linear homogeneous and non-homogeneous equations, finding the inverse of a given square matrix and also its Eigen values and Eigen vectors
2. Identify the type of a given differential equation and select and apply the appropriate analytical technique for finding the solution of first order and higher order ordinary differential equations.
3. Create and analyse mathematical models using first and second order differential equations to solve application problems that arises in engineering.
4. To learn about solving linear Differential equations with constant coefficients with the given initial conditions using Laplace transform technique.

Course Outcomes: Students will be able to

CO 1 To learn about solving a system of linear homogeneous and non-homogeneous equations, finding the inverse of a given square matrix and also its Eigen values and Eigen vectors.

CO 2 Identify the type of a given differential equation and select and apply the appropriate analytical technique for finding the solution of first order and higher order ordinary Differential equations.

CO 3 Create and analyze mathematical models using first and second order differential equations to solve application problems that arises in engineering.

CO 4 To learn about solving linear Differential equations with constant coefficients with the given initial conditions using Laplace transform technique

UNIT-I

Linear Algebra: Rank of a Matrix; Elementary transformations of a matrix; Gauss-Jordan method of finding the inverse; Consistency of linear System of equations: Rouches theorem, System of linear Non-homogeneous equations, System of linear homogeneous equations; vectors; Eigen values; properties of Eigen values(without proofs); Cayley-Hamilton theorem (without proof).

[Sections: 2.7.1; 2.7.2; 2.7.6; 2.10.1; 2.10.2; 2.10.3; 2.12.1; 2.13.1; 2.14; 2.15.]

[12 Hours]

UNIT-II

Differential Equations of first order: Definitions; Formation of a Differential equation; Solution of a Differential equation; Equations of the first order and first degree; variables separable; Linear Equations; Bernoulli‟s equation; Exact Differential equations; Equations

reducible to Exact equations: I.F found by inspection, I.F of a Homogeneous equation, In the equation M dx+ N dy=0.

Applications of a first order Differential equations: Newton‟s law of cooling; Rate of decay of Radio-active materials.

[Sections: 11.1; 11.3; 11.4; 11.5; 11.6; 11.9; 11.10; 11.11; 11.12.1; 11.12.2; 11.12.4; 12.6; 12.8] [12 Hours]

UNIT-III

Linear Differential Equations: Definitions; Theorem; Operator D; Rules for finding the complementary function; Inverse operator; Rules for finding the Particular Integral; Working procedure to solve the equation; Method of Variation of Parameters; Applications of Linear Differential Equations: Oscillatory Electrical Circuits.

[Sections: 13.1; 13.2.1; 13.3; 13.4; 13.5; 13.6; 13.7;13.8.1;14.1;14.5] [12 Hours]

UNIT-IV

Laplace Transforms: Definition; conditions for the existence; Transforms of elementary functions; properties of Laplace Transforms; Transforms of derivatives; Transforms of integrals; Multiplication by t^n; Division by t; Inverse transforms- Method of partial fractions; Other methods of finding inverse transforms; Convolution theorem(without proof); Application to differential equations: Solution of ODE with constant coefficients using Laplace transforms.

[Sections:21.2.1; 21.2.2; 21.3; 21.4; 21.7; 21.8; 21.9; 21.10; 21.12; 21.13; 21.14; 21.15.1]

[12 Hours]

TEXT BOOKS

1. B.S.Grewal, “Higher Engineering Mathematics”, 44thedition, Khanna publishers, 2017.

REFERENCE BOOKS

1. ErwinKreyszig, “Advanced Engineering Mathematics”, 9th edition, John Wiley & Sons.
2. N.P.Bali and M.Goyal, “A Text book of Engineering Mathematics” Laxmi Publications, 2010.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2		1										1	
CO2	3	1		1										1	
CO3	3	3		2										2	
CO4	3	3		2										3	

PHYSICS
(Advanced Optics and Material Testing)
20ME102/PH01
Ist Year B. Tech. First Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To circulate the knowledge about the advanced optics and know its Engineering applications.
2. To familiarize the basis of quantum theory and to make students to solve the physical problems.
3. To classify solids and to have a basic idea about the structural determination of crystals.
4. To make aware of some of the analytical techniques for material testing.

Course Outcomes:

CO 1 Student's ability to understand the principles in the production and application of lasers and their effective utilization in optical communications.
CO 2 Students demonstrate appropriate competence and working knowledge of laws of modern physics in understanding advanced technical engineering courses.
CO 3 Students demonstrate the ability to apply knowledge of band theory of solids and to make understand the concept of energy band gap and hole.
CO 4 Ability to understand the crystal geometrics and estimation of crystal structure by X-ray diffraction technique.
CO 5 Student's ability to understand the principle in the production and applications of ultrasonics and extend it for material testing using various nuclear techniques.

UNIT-I

ADVANCED OPTICS

Lasers: Interaction of radiation with matter. Einstein co-efficient, Properties of laser, Population inversion, LASER principle, pumping schemes-Three level and four level laser, Types of lasers: solid-state lasers (Ruby), gas lasers (He-Ne), Semiconductor lasers; applications of lasers in industry and medicine.

Fibre Optics: Importance of optical fibre, Structure and principle of optical fibre, acceptance angle and numerical aperture, Types of optical fibres based on modes and refractive index, V-number, losses associated with optical fibres, fibre optical communication, advantages of optical fibres

UNIT-II

Quantum Mechanics

Dual nature of light, de-Brogli‟s concept of matter waves, Davisson-Germer electron diffraction experiment, Heisenberg Uncertainty principle and applications (non-existence of

electron in a nucleus and finite width of spectral lines), one dimensional time- independent and dependent Schrödinger wave equations, physical significance of wave function, applications of time-independent Schrödinger wave equation to particle in a box (one dimensional), tunneling, the scanning tunneling microscope.

UNIT-III

Band theory of solids and Structure determination

Band theory of Solids: Failures of classical free electron theory, success and failures of quantum free electron theory, Bloch theorem statement, Kronig-Penny model (without derivation), effective mass of electron, concepts of energy band gap and hole.

Structure determination: Crystal lattices (Bravias), Crystal systems and structures, planes, Miller indices, Bragg‟s law, structural analysis of crystals using X-Ray powder diffraction method (XRD).

UNIT-IV

Ultrasonics and Nuclear Techniques

Ultrasonics: Properties of ultrasonics, General applications of ultrasonics.

Applications of Ultrasonic Testing: Weld inspection, Material analysis, corrosion testing, concrete under water measurements, Ultrasonic testing in the foundry industry.

NDT: Production of Ultrasonic waves, Pulse echo technique, time of flight diffraction technique, A –scan presentation, B- scan presentation, C –scan presentation.

Nuclear Techniques: Nuclear radio isotopes, Applications of radio isotopes (medical and industry) Properties of α,β,γ-rays and radiographic testing (NDT).

TEXT BOOKS

1. A Text Book of Engineering Physics ,M.N.Avadhanulu& P. Kshirsagar, S.Chand& Co., (Edition – 2013).
2. Engineering physics by S.O.Pillai

REFERENCE BOOKS

1. Engineering physics by R .K.Gour and S.L.Gupta. Dhanpatrai publications.
2. Engineering physics by M .R.Sreenivasan. New age international publications
3. Engineering physics by Palaniswamy. Scitechpublications.
4. Basic engineering physics – Dr.P.srinivasaRao, Dr.K.Muralidhar, Himalaya publication
5. Applied physics - Dr.P.srinivasaRao, Dr.K.Muralidhar, Himalaya publication
6. Engineering physics by Dr.D.Thirupathi Naidu, M. Veeranjaneyulu.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															

Basic Electrical and Electronics Engineering

20ME103/EE01

Ist Year B. Tech. First Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment	:	30	Semester End Examination (3 Hours)	:	70		

Prerequisites: Mathematics, Physics

Course Objectives: Students will be able

1. To understand basic Laws in circuits, analysis of simple DC circuits, Theorems and its applications, fundamentals of AC circuits & its analysis and concepts of three phase balanced circuits.
2. To learn basic properties of magnetic materials and its applications.
3. To understand working principle, construction, applications and performance of DC machines and AC machines.
4. To learn basic concepts, working principal, characteristics and applications of semiconductor diode and transistor family.
5. To gain knowledge about the static converters and regulators.
6. To learn basic concepts of power transistors and operational amplifiers closer to practical applications.

Course Outcomes: Students will be able to

CO1: Solve problems involving with DC and AC excitation sources in electrical circuits.

CO2: Compare properties of magnetic materials and its applications.

CO3: Analyze construction, principle of operation, application and performance of DC machines and AC machines.

CO4: Explore characteristics and applications of semiconductor diode and transistor family.

CO5: Make the static converters and regulators.

CO6: Analyze concepts of power transistors and operational amplifiers closer to practical applications.

UNIT – I

Electrical Circuits

Electrical circuit elements (R, L and C), voltage and current sources, Kirchhoff current and voltage laws, analysis of simple circuits with dc excitation.Superposition, Thevenin and Norton Theorems. Representation of sinusoidal waveforms, peak and rms values, phasor representation, real power, reactive power, apparent power, power factor. Analysis of single-phase AC circuits consisting of R, L, C, RL, RC, RLC combinations (series and parallel). Three-phase balanced circuits, voltage and current relations in star and delta connections.

UNIT –II

Electrical Machines (18 hours)

Magnetic materials, BH characteristics, Construction, working of DC machines, ideal and practical transformer, equivalent circuit, losses in transformers, regulation and efficiency.Auto-transformer. Generation of rotating magnetic fields, Construction and working of a three-phase induction motor, Significance of torque-slip characteristic, DOL starter. Single-phase induction motor.Construction and working of synchronous generators.

UNIT-III

Semiconductor Diodes and applications

Semiconductor materials, semiconductor diode, Resistance levels, Diode equivalent circuits, Zener diode, Light emitting diode, Load line analysis, half wave rectification, Full wave rectification, Use of capacitor filter in rectifier, Zener diode voltage regulator, Clippers, Clampers

Bipolar Junction Transistors

Transistor construction and operation, Common base configuration, Transistor amplifying action, Common emitter configuration, Common collector configuration, Limits of operation.

UNIT-IV

Field Effect Transistors

Construction and characteristics of JFET and MOSFET

Operational Amplifiers

Introduction, Differential and common mode operation, OP-AMP Basics, Practical OP-AMP circuits: Inverting amplifier, Non inverting amplifier, Unity follower, summing amplifier, Integrator and differentiator.

TEXT BOOK:

1. S.K. Bhattacharya, “Basic Electrical and Electronics Engineering”, Pearson Publications
2. Robert L. Boylestad& Louis Nashelsky, ‘ Electronic Devices and circuit theory’, PHI Pvt.Limited, 11th edition
3. “Basics of Electrical and Electronics Engineering”, Nagsarkar T K and Sukhija M S, Oxford press University Press.

Reference Books:

1. David A. Bell, ‘Electronic Devices and Circuits’, oxford publisher,5th edition
2. “Basic Electrical, Electronics and Computer Engineering”, Muthusubramanian R, Salivahanan S and Muraleedharan K A, Tata McGraw Hill, Second Edition, (2006).

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1															
CO2															
CO3															
CO4															

Engineering Mechanics – I

20ME104

Ist Year B. Tech. First Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment	:	30	Semester End Examination (3 Hours)	:	70		

Prerequisites: None

Course Objectives:

To introduce the students to basic laws and principles of Engineering Mechanics with emphasis on the analysis and application to practical Engineering problems, where bodies and systems are in static equilibrium.

Course Outcomes: After the completion of the course the students will be able to

CO 1 Find the resultant and analyse the equilibrium of a coplanar concurrent and parallel force systems.

CO 2 Find the resultant and analyse the equilibrium of a general force systems and apply Coulombs laws of dry friction and analyse bodies and systems subjected to coplanar forces.

CO 3 Deduce the centroids of areas bounded by curves & composite areas.

CO 4 Find the moment of inertias of areas bounded by curves & composite areas.

UNIT I

Introduction:

Engineering Mechanics - Units and dimensions - Method of problem solution and the accuracy of solutions.

Concurrent forces in a plane:

Principles of statics - Composition and resolution of forces - Equilibrium of concurrent forces in a plane - Method of projections - Method of moments.

Parallel forces in a plane:

Couple - Resultant and Equilibrium of parallel forces in a plane. (12)

UNIT II

General case of forces in a plane:

Composition of forces in a plane - Equilibrium of forces in a plane - Analysis of trusses: Method of joints

Friction:

Introduction - Laws of dry friction - Problems involving dry friction: Connected bodies on rough horizontal and inclined planes, Ladder friction and Wedge friction. (12)

UNIT III

Centroid, Centre of Mass and Centre of Gravity:

Concept of Centroid, Centre of Mass and Centre of Gravity - Centroid of two-dimensional bodies - Problems on locating centroids of simple and composite plane figures and curves – Pappus theorems. (12)

UNIT IV

Moments of Inertia of Plane figures:

Moments of inertia of a plane figure with respect to an axis in its plane and an axis perpendicular to the plane of the figure - Parallel axis theorem - Moments of inertia of simple and composite figures. (12)

TEXT BOOKS:

1. Engineering Mechanics (in SI units) by S Timoshenko, D H Young, J V Rao and SukumarPati, McGraw Hill Education, 5th edition, 2016.
2. Engineering Mechanics: Statics and Dynamics by A K Tayal, Umesh publications, 14th edition, 2015.

REFERENCE BOOKS:

1. Vector mechanics for Engineers: Statics and Dynamics by Ferdinand Beer, E Russell Johnston Jr, David Mazurek, Phillip Cornwell, Brian Self and SanjeevSanghi, McGraw Hill Education, 11th edition, 2017.
2. Engineering Mechanics: Statics and Dynamics by R C Hibbeler, Pearson, 14th edition, 2017.
3. Engineering Mechanics (Statics) by J L Meriam and L G Kraige, Wiley student edition, 7th edition.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	3	
CO2	2	2											2	2	
CO3	3	2										1	2	2	
CO4	3	2										1	2	2	

PROBLEM SOLVING USING PROGRAMMING

20ME105/CS001

I Year B. Tech. First Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives: students will be able to

1. Understand basic concepts of C Programming such as: C-tokens, Operators, Input/output, and Arithmetic rules.
2. Develop problem-solving skills to translate "English" described problems into programs written using C language.
3. Use Conditional Branching, Looping, and Functions.
4. Apply pointers for parameter passing, referencing and differencing and linking data structures.
5. Manipulate variables and types to change the problem state, including numeric, character, array and pointer types, as well as the use of structures and unions, File.

Course Outcomes: After completion of the course the students will be able to

CO 1 Choose the right data representation formats based on the requirements of the problem.

CO 2 Analyse a given problem and develop an algorithm to solve the problem.

CO 3 Use the comparisons and limitations of the various programming constructs and choose the right one for the task in hand.

CO 4 Write the program on a computer, edit, compile, debug, correct, recompile and r unit.

CO 5 Identify tasks in which the numerical techniques learned are applicable and apply them to write programs, and hence use computers effectively to solve the task.

UNIT-I

Overview of C, Constants, Variables and Data Types, Operators and Expressions, Managing I/O Operations.Decision Making and Branching.

Programming Exercises: C-expressions for algebraic expressions, evaluation of arithmetic and Boolean expressions. Syntactic and logical errors in a given program, output of a given program, values of variables at the end of execution of a program fragment, Programs using Scientific and Engineering formulae. Finding the largest of the three given numbers.Computationofdiscountamountondifferenttypesofproductswithdifferent discount percentages. Finding the class of an input character, finding the type of triangle formed with the given sides, computation of income-tax, finding given year is leap year or not, and conversion of lower case character to its upper case.

UNIT-II

Decision Making and Looping, Arrays, Character Arrays and Strings.

Programming Exercises for Unit II: To print the sum of the digits of a given number and to display the image of a given number. To find whether a given number is prime, printing Fibonacci sequence and to find prime factors of a given number.To print graphic patterns of symbols and numbers.To find the length of a string, compare strings, reverse a string,

copy a string and to find whether the given string is palindrome or not with and without using String Handling Functions. Transpose of a matrix and sorting of names using arrays.

UNIT-III

User-defined Functions, Structures and Unions, Pointers

Programming Exercises for Unit - III: Functions - Recursive functions to find factorial & GCD (Greatest Common Divisor), string operations using pointers and pointer arithmetic. Swapping two variable values. Sorting a list of student records on register number using array of pointers.

UNIT-IV

File Management in C, Dynamic Memory Allocation, Pre-processor

Programming Exercises for Unit - IV: Operations on complex numbers, and to read an input file of marks and generate a result file, sorting a list of names using command line arguments. Copy the contents of one file to another file. Allocating memory to variables dynamically.

TEXT BOOKS

1. Kernighan BW and Dennis Ritchie M, "C programming language", 2nded, Prentice Hall.
2. Yashavant P. Kanetkar, "Let us C", BPB Publications.
3. Herbert Schildt, "C: The Complete Reference", 4th edition, Tata Mcgraw-Hill.
4. Ashok N.Kamthane, "Programming in C", PEARSON 2nd Edition.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	2	2	2	1								2	2
CO2	2	2	2	2	3	2	1						1	2	2
CO3	2	1	2	2	2	3	2						2	2	2
CO4	2	1	2	2	2	1	2						1	2	2

PHYSICS LABORATORY

20MEL101/PHL01

Ist Year B. Tech.First Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

LIST OF EXPERIMENTS

1. Determination of acceleration due to gravity at a place using compound pendulum.
2. Study the variation of intensity of magnetic field along the axis of a circular coil using Stewart-Gee's apparatus.
3. Determination of thickness of thin wire using air wedge interference bands.
4. Determination of radius of curvature Plano convex lens by forming Newton rings.
5. Determination of wavelengths of mercury spectrum using grating normal incidence method.
6. Determination of dispersive power of a given material of prism using prism minimum deviation method.
7. Draw the resonant characteristic curves of L.C.R. series circuit and calculate the resonant frequency.
8. Draw the characteristic curves of a photocell and calculate the maximum velocity of electron.
9. Verify the laws of transverse vibration of stretched string using sonometer.
10. Determine the rigidity modulus of the given material of the wire using Torsional pendulum.
11. Draw the load characteristic curves of a solar cell.
12. Determination of Hall coefficient of a semiconductor.
13. Determination of voltage and frequency of an A.C. signal using C.R.O.
14. Determination of Forbidden energy gap of Si &Ge.
15. Determination of wavelength of laser source using Diode laser.

Any three experiments are virtual

TEXT BOOK:

1. Engineering physics laboratory manual P.Srinivasarao&K.Muralidhar, Himalaya publications.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1															
CO2															
CO3															
CO4															

BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB

20MEL102/EEL01

I Year B. Tech. First Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Lab experiments

1. Verification of KCL and KVL
2. Verification of Superposition theorem
3. Verification of Thevenin's theorem
4. Verification of Norton's theorem
5. Parameters of choke coil
6. Measurement of low and medium resistance using volt ampere method
7. Study on various parts of DC and AC machines
8. OC & SC test of single-phase transformer
9. Load test on single phase transformer
10. V-I characteristics of PN junction Diode
11. V-I characteristics of Zener Diode
12. Characteristics of CE Configuration
13. Transfer and Drain Characteristics of JFET
14. Calculation of Ripple factor using Half wave rectifier
15. Calculation of Ripple factor using Full wave rectifier
16. Nonlinear wave shaping – clippers/clampers

Note: Minimum 10 experiments should be carried.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1															
CO2															
CO3															
CO4															

PROBLEM SOLVING USING PROGRAMMING LAB

20MEL103/CSL01

Ist Year B. Tech. First Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

1. A program for electricity bill taking different categories of users, different slabs in each category. (Using nested if-else statement).

Domestic Customer:		
Consumption Units	**Rate of Charges(Rs.)**	
0 – 200	0.50 per unit	
201 – 400	100 plus	0.65 per unit
401 – 600	230 plus	0.80 per unit
601 and above	390 plus	1.00 per unit
Commercial Customer:		
Consumption Units	**Rate of Charges(Rs.)**	
0 – 100	0.50 per unit	
101 – 200	50 plus	0.6 per unit
201 – 300	100 plus	0.70 per unit
301 and above	200 plus	1.00 per unit

2. Write a C program to evaluate the following (using loops):
   a) $1 + x^2/2! + x^4 / 4!+$ …upto ten terms
   b) $x + x^3/3! + x^5/5!+$ … upto ten terms
3. Write a C program to check whether the given number is
   a) Prime or not.
   b) Perfect or Abundant or Deficient.

4. Write a C program to display statistical parameters (using one – dimensional array).
   a) Mean
   b) Mode
   c) Median
   d) Variance.

5. WriteaCprogramtoreadalistofnumbersandperformthefollowingoperations

a) Print the list.
b) Delete duplicates from the list.
c) Reverse the list.

6. Write a C program to read a list of numbers and search for a given number using Binary search algorithm and if found display its index otherwise display the message “Element not found in the List”.

7. Write a C program to read two matrices and compute their sum and product.

8. Write a C program to read list of student names and perform the following operations

a) To print the list of names.
b) To sort them in ascending order.
c) To print the list after sorting.

9. Write a C program that consists of recursive functions to

a) Find factorial of a given number
b) Solve towers of Hanoi with three towers (A, B & C) and three disks initially on tower A.

10. A Bookshop maintains the inventory of books that are being sold at the shop. The list includes details such as author, title, price, publisher and stock position. Whenever a customer wants a book the sales person inputs the title and the author, and the system searches the list and displays whether it is available or not. If it is not, an appropriate message is displayed, if it is, then the system displays the book details and request for the number of copies required ,if the requested copies are available the total cost of the requested copies is displayed otherwise the message “required copies not in stock” is displayed. Write a program for the above in structures with suitable functions.

11. Write a C program to read a data file of students’ records with fields (Regd. no, Name, M1,M2,M3,M4,M5) and write the successful students data (percentage > 40%) to a data file.

12. Write a C program to read a file as command line argument and count the given word frequency in a file

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	2	2	1								2	2
CO2	2	2	1	2	3	2	1							2	2
CO3	2	1	2	1	2	3	1							2	2
CO4	2	1	1	1	2	1	1							2	2

MATHEMATICS II

(Numerical Methods And Advanced Calculus)

20ME201/MA02

IstYear B. Tech. Second Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To learn about some advanced numerical techniques e.g. solving a nonlinear equation, linear system of equations, Interpolation and Approximation techniques.
2. To learn about evaluation of double and triple integrals and their applications.
3. To learn some basic properties of scalar and vector point functions and their applications to line, surface and volume integrals.

Course Outcomes: Students will be able to

1. Tolearn about some advanced numerical techniques e.g. solving a nonlinear equation, linear system of equations.
2. To learn about some Interpolation and Approximation techniques.
3. To learn about evaluation of double and triple integrals and their applications.
4. To learn some basic properties of scalar and vector point functions and their applications to line, surface and volume integrals.

UNIT-I

Numerical Solution of Equations: Introduction; Solution of algebraic and transcendental equations: Bisection method, Method of false position, Newton-Raphson method; Useful deductions from the Newton-Raphson formula; Solution of linear simultaneous equations; Direct methods of solution: Gauss elimination method, Gauss-Jordan method, Factorization method; Iterative methods of solution: Jacobi‟s iterative method, Gauss-Seidel iterative method.

[Sections: 28.1; 28.2; 28.3; 28.5; 28.6; 28.7.1;28.7.2]. [12 Hours]

UNIT-II

Finite differences and Interpolation: Finite differences: Forward differences, Backward differences; Newton‟s interpolation formulae: Newton‟s forward interpolation formula, Newton‟s backward interpolation formula; Interpolation with unequal intervals; Lagrange‟s interpolation formula; Divided differences; Newton‟s divided difference formula; Numerical integration; Trapezoidal rule; Simpson‟s one-third rule; Simpson‟s three-eighth rule; Numerical solution of ODE‟s: Introduction; Picard‟s method; Euler‟s method; Runge-Kutta method.

[Sections:29.1; 29.1-1; 29.1.2; 29.6; 29.9; 29.10; 29.11; 29.12; 30.4; 30.6; 30.7; 30.8; 32.1; 32.2; 32.4; 32.7]. [12 Hours]

UNIT-III

Multiple Integrals: Double integrals; Change of order of integration; Double integrals in polar coordinates; Area enclosed by plane curves; Triple integrals; Volumes of solids: Volume as Triple integrals, Change of variables.

[Sections: 7.1; 7.2; 7.3; 7.4; 7.5; 7.6.2; 7.7.2]. [12 Hours]

UNIT-IV

Vector calculus and its Applications: Scalar and vector point functions; Del applied to scalar point functions-Gradient: Definition, Directional derivative; Del applied to vector point functions: Divergence, Curl; Line integral; Surfaces: Surface integral, Flux across a surface; Green‟s theorem in the plane (without proof); Stokes theorem (without proof); Gauss divergence theorem(without proof).

[Sections: 8.4; 8.5.1; 8.5.3; 8.6; 8.11; 8.12; 8.13; 8.14; 8.16] [12 Hours]

TEXT BOOKS

1. B.S.Grewal, "Higher Engineering Mathematics", 44thedition, Khanna publishers, 2017.

REFERENCE BOOKS

1. ErwinKreyszig, "Advanced Engineering Mathematics", 9th edition, John Wiley & Sons.
2. N.P.Bali and M.Goyal, "A Text book of Engineering Mathematics" Laxmi Publications, 2010.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	1		1										2	
CO2	3	2		2										2	
CO3	3	3		2										1	
CO4	3	3		2										1	

ENGINEERING CHEMISTRY

20ME202/CY01

Ist Year B. Tech. Second Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. With the principles of water characterization and treatment of water for industrial purposes and methods of producing water for potable purposes.
2. To understand the thermodynamic concepts, energy changes, concept of corrosion & its control.
3. With the conventional energy sources, solid, liquid and gaseous Fuels & knowledge of knocking and anti-knocking characteristics.
4. With aim to gain good knowledge of organic reactions, plastics, conducting polymers & biodegradable polymers.

Course Outcomes: Students will be able to

1. Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost.
2. Apply their knowledge in converting various energies of different systems and protection of different metals from corrosion.
3. Have the capacity of applying energy sources efficiently and economically for various needs.
4. Design economically and new methods of organic synthesis and substitute metals with conducting polymers and also produce cheaper biodegradable polymers to reduce environmental pollution.

UNIT-I

Water chemistry **15hrs**

Introduction: water quality parameters

Characteristics: Alkalinity, Hardness **-** Estimation & simple numerical problems, **Boiler Troubles** - Sludges, Scales, Caustic embrittlement, boiler corrosion, Priming and foaming;

Internal conditioning- phosphate, calgon and carbonate methods.

External conditioning - Ion exchange process & Zeolite proess

WHO Guidelines, Potable water, Sedimentation, Coagulation, Filtration. Disinfection methods: Chlorination, ozonization and UV treatment.

Salinity – Treatment of Brackish water by Reverse Osmosis and Electro-dialysis.

UNIT-II **15hrs**

Thermodynamic functions: energy, entropy and free energy. Estimations of entropy and free energies.Free energy and emf.Cell potentials, the Nernst equation and applications.

Corrosion: Types of corrosion - Chemical or dry corrosion, Electrochemical or wet corrosion; Galvanic, stress, pitting and differential aeration corrosion; Factors effecting corrosion, **Corrosion control** – Cathodic protection, and electro plating (Au) &electoless Ni plating.

UNIT-III

Fuels **15hrs**

Classification of fuels; Calorific value of fuels (lower, higher)

Solid fuels: Determination of calorific value (Bomb Calorimeter) & related problems, Coal ranking,

Liquid Fuels: Petroleum refining and fractions, composition and uses. Knocking and anti-knocking Agents, Octane number and Cetane number; Bio fuels- Biodiesel, general methods of preparation and advantages

Gaseous fuels: CNG and LPG, Flue gas analysis – Orsat apparatus.

UNIT-IV

Organic reactions and synthesis of a drug molecule

Introduction to reactions involving substitution (SN^1, SN^2), addition (Markownikoff‟s and anti-Markwnikoff‟s rules) , elimination (E_1& E_2), Synthesis of a commonly used drug molecule.(Aspirin and Paracetamol)

Polymers: Conducting polymers: Classification, Intrinsic and Extrinsic conducting polymers and their applications**.** Plastics: Thermoplasts and thermosetting plastics, Bskelite and PVC. Bio degradable polymers: types, examples-Polyhydroxybuterate (PHB), Polyhydroxybuterate-co-β-hydroxyvalerate (PHBV), applications.

TEXT BOOKS

1. P.C. Jain and Monica Jain, “Engineering Chemistry” DhanpatRai Pub, Co., New Delhi 17th edition (2017).
2. SeshiChawla, “Engineering Chemistry ”DhanpatRai Pub, Co LTD, New Delhi 13th edition, 2013.

REFERENCE BOOKS

1. Essential Of Physical Chemistry by ArunBahl, B.S. Bahl, G.D.Tuli, byArunBahl, B.S. Bahl, G.D.Tuli, Published byS Chand Publishers, 12th Edition, 2012.
2. Text Book of Engineering Chemistry by C.P. Murthy, C.V. Agarwal, A. Naidu B.S. Publications, Hyderabad (2006).
3. Engineering Chemistry by K. Maheswaramma, Pearson publishers 2015

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1			2	3						2		
CO2	3	3	2			2	2								
CO3	3	3				2	3								
CO4	3	3	2			2	1								1

COMMUNICATIVE ENGLISH

20ME203/EL01

Ist Year B. Tech. Second Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

UNIT-I

1.1 **Vocabulary Development**: Word formation-Formation of Nouns, Verbs & Adjectives from Root words-Suffixes and Prefixes

1.2 **Essential Grammar:** Prepositions, Conjunctions, Articles

1.3 **Basic Writing Skills**: Punctuation in writing

1.4 **Writing Practices**: Mind Mapping, Paragraph writing (structure-Descriptive, Narrative, Expository & Persuasive)

UNIT-II

2.1 **Vocabulary Development**: Synonyms and Antonyms

2.2 **Essential Grammar**: Concord, Modal Verbs, Common Errors

2.3 **Basic Writing Skills**: Using Phrases and clauses

2.4 **Writing Practices**: Hint Development, Essay Writing

UNIT-III

3.1 **Vocabulary Development**: One word Substitutes

3.2 **Essential Grammar**: Tenses, Voices

3.3 **Basic Writing Skills**: Sentence structures (Simple, Complex, Compound)

3.4 **Writing Practices**: Note Making

UNIT-IV

4.1 **Vocabulary Development**: Words often confused

4.2 **Essential Grammar**: Reported speech, Common Errors

4.3 **Basic Writing Skills**: Coherence in Writing: Jumbled Sentences

4.4 **Writing Practices**: Paraphrasing &Summarising

REFERENCE BOOKS

- Communication Skills, Sanjay Kumar &PushpaLatha. Oxford University Press:2011.
- Practical English Usage, Michael Swan. Oxford University Press:1995.
- Remedial English Grammar, F.T.Wood. Macmillan:2007.
- Study Writing, Liz Hamplyons& Ben Heasley. Cambridge University Press:2006

Course Objectives

The course aims

1. at enhancing the vocabulary competency of the students
2. to enable the students to demonstrate proficiency in the use of written English, including proper spelling, grammar, and punctuation
3. to enhance theoretical and conceptual understanding of the elements of grammar
4. understand and apply the conventions of academic writing in English
5. to enhance the learners' ability of communicating accurately and fluently

Course Outcomes

1. able to build academic vocabulary to enrich their writing skills
2. produce accurate grammatical sentences
3. make inferences and predictions based on comprehension of a text
4. discuss and respond to content of the text in writing
5. produce coherent and unified paragraphs with adequate support and detail

CO-PO Mapping

CO/PO	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII
1								2		4		3
2							2	2		4	4	3
3							2	2		4	4	3
4								2		4	4	3
5							3	2		4	3	3

Engineering Mechanics – II

20ME204

Ist Year B. Tech. Second Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment	:	30	Semester End Examination (3 Hours)	:	70		

Course Objectives:

To introduce the students to the principles of particle and rigid body dynamics in terms of kinematics and kinetics, with emphasis on the analysis and application to practical Engineering problems limited to motion in a plane.

Course Outcomes: After the completion of the course the students will be able to

CO 1 Develop relationships between different parameters of motion of a particle in a plane to analyse rectilinear and curvilinear motions.

CO 2 Analyze the motion parameters and forces acting on a particle by relating them using Newton's laws of motion and dynamic equilibrium concept.

CO 3 To relate the motion parameters and forces acting on a particle using the principles of work & energy, impulse & momentum and derive the mass moment of inertia of 3D bodies.

CO 4 Develop relationships between different parameters of motion and the forces to analyse bodies undergoing fixed axis rotation and general plane motion.

UNIT I

Kinematics of Particle: Rectilinear Translation

Introduction to Dynamics – Displacement, Velocity and Acceleration – Graphical representations – Motion with uniform acceleration – Motion with variable acceleration.

Kinematics of Particle: Curvilinear Translation

Introduction – Position vector, Velocity and Acceleration – Components of motion: Rectangular and Normal & tangential. (12)

UNIT II

Relative Motion

Introduction – Relative motion between two particles: Position, Velocity and Acceleration.

Kinetics of Particle: Equations of motion

Equations of rectilinear motion – D'Alembert's principle in rectilinear motion - Equations of curvilinear motion: Rectangular components and Normal & tangential components - D'Alembert's principle in curvilinear motion. (12)

UNIT III

Kinetics of Particle: Work and Energy – Impulse and Momentum – Impact

Introduction – Principle of work and energy – Potential energy and conservative forces – Principle of conservation of energy – Principle of impulse and momentum – Conservation of momentum – Direct central impact.

Moment of Inertia of Material bodies:

Moment of inertia of a rigid body – Moment of inertia of laminas – Moment of inertia of three dimensional bodies: Solid right circular cone, Solid cylinder and Sphere (12)

UNIT IV

Kinematics of Rigid Body:

Introduction – Rotation – Parameters of motion of a body rotating about a fixed axis – General plane motion – Absolute and relative velocity in plane motion – Instantaneous centre of rotation in plane motion.

Kinetics of Rigid Body: Equations of motion

Introduction – Equations of motion – Relation between translatory motion and rotary motion of a body in plane motion – D'Alembert's principle in plane motion. (12)

TEXT BOOKS:

1. Engineering Mechanics (in SI units) by S Timoshenko, D H Young, J V Rao and SukumarPati, McGraw Hill Education, 5th edition, 2016.
2. Engineering Mechanics: Statics and Dynamics by A K Tayal, Umesh publications, 14th edition, 2015.

REFERENCE BOOKS:

1. Vector mechanics for Engineers: Statics and Dynamics by Ferdinand Beer, E Russell Johnston Jr, David Mazurek, Phillip Cornwell, Brian Self and SanjeevSanghi, McGraw Hill Education, 11th edition, 2017.
2. Engineering Mechanics: Statics and Dynamics by R C Hibbeler, Pearson, 14th edition, 2017.
3. Engineering Mechanics (Dynamics) by J L Meriam and L G Kraige, Wiley student edition, 7th edition.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2											2	2	
CO2	2	2											2	2	
CO3	2	2										2	2	2	
CO4	3	2										2	2	2	

ENVIRONMENTAL STUDIES

20MC01/CE01

I Year B. Tech. Second Semester

Lectures	2	Tutorial	0	Practical	0	Credits	0
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			NILL

Course Objectives:

1. To develop an awareness, knowledge, and appreciation for the natural environment.
2. To understand different types of ecosystems exist in nature.
3. To know our biodiversity.
4. To understand different types of pollutants present in Environment.
5. To know the global environmental problems.

Course Outcomes: Students will be able to

1. Develop an appreciation for the local and natural history of the area.
2. Hope for the better future of environment in India which is based on many positive factors like Biodiversity, successive use of renewable energy resources and other resources, increasing number of people's movements focusing on environment.
3. Know how to manage the harmful pollutants.
4. Gain the knowledge of Environment.
5. Create awareness among the youth on environmental concerns important in the long-term interest of the society

UNIT-I

Introduction: Definition, Scope and Importance, Need for public awareness. Ecosystems: Definition, Structure and Functions of Ecosystems, types - Forest, Grassland, Desert, Aquatic (Marine, pond and estuaries). *6 periods*

Biodiversity: Definition and levels of Biodiversity; Values of Biodiversity - Consumptive, Productive, Social, Aesthetic, Ethical and Optional; Threats and Conservation of Biodiversity; Hot Spots of Biodiversity, Bio-geographical Classification of India, India as a mega diversity nation. *Chipko movement case study* *6 periods*

UNIT-II

Natural resources: Land: Land as a resource, Causes and effects of land degradation - Soil erosion, Desertification. **Forest**: Use of forests, Causes and effects of deforestation, Afforestation, Mining - benefits and problems. **Water**: Uses, floods and drought, Dams - benefits and problems.

Energy: Importance of energy, Environmental Impacts of Renewable and Non-renewable energy resources. *Silent Valley Project and Narmada BachaoAndolan case studies8 periods*

Sustainability: Definition, Concept and Equitable use of resources for sustainable development; Rain water harvesting and Watershed management. Fieldwork on Rain

water harvesting and Watershed management.*6 periods + 6 hours field work/Demonstration*

UNIT-III

Pollution: Definition; Causes, effects and control of air, water and nuclear pollution; *Chernobyl Nuclear Disaster* case study; Solid Waste: urban, Industrial and hazardous wastes; Integrated waste management - 3R approach, composting and vermin-composting. *12 periods*

Environmental acts: Water and air (Prevention and Control of pollution) acts, Environmental protection act, Forest Conservation act.

6 periods

UNIT-IV

Environmental issues: Green house effect & Global warming, Ozone layer depletion, Acid rains, Green Revolution, Population Growth and environmental quality, Environmental Impact Assessment. Environmental Standards (ISO 14000, etc.) *12 periods*

Case Studies: Bhopal Tragedy, Mathura Refinery and TajMahal, and Ralegan Siddhi (Anna Hazare). *6 periods*

Field work: Visit to a local area to document environmental assets – Pond/Forest/Grassland. Visit to a local polluted site- Urban and industry/ Rural and Agriculture. *6 periods*

TEXT BOOKS

1. "Environmental Studies" by Benny Joseph, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. "Comprehensive environmental studies"- JP Sharma, Laxmi Publications.
3. Text Book of environmental Studies – ErachBharucha

REFERENCE BOOKS

1. "Environmental studies", R.Rajagopalan, Oxford University Press.
2. "Introduction to Environmental Science", Anjaneyulu Y, B S Publications
3. "Environmental Science", 11th Edition – Thomson Series – By Jr. G. Tyler Miller.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1															
CO2															
CO3															
CO4															

ENGINEERING GRAPHICS

20MEL201/MEL01

I Year B. Tech. Second Semester

Lectures	1	Tutorial	0	Practical	3	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. Clear picture about the importance of engineering graphics in the field of engineering
2. The drawing skills and impart students to follow Bureau of Indian Standards
3. To give an idea about Geometric constructions, Engineering curves, orthographic projections and pictorial projections
4. Imagination skills about orientation of points, lines, surfaces and solids
5. Basic drafting skills of AutoCAD

Course Outcomes: After completion of the course the students will be able to

CO 1 Draw projections of points and projections of lines using Auto CAD

CO 2 Plot projections of surfaces like circle, square and rhombus

CO 3 Plot the Projections of solids like Prisms and pyramids

CO 4 Convert the of Orthographic views into isometric views and vice-versa of simple objects

UNIT-I

INTRODUCTION: Introduction to Drawing instruments and their uses, geometrical construction procedures

INTRODUCTION TO AUTOCAD:

Basics of sheet selection, Draw tools, Modify tools, dimensioning

METHOD OF PROJECTIONS: Principles of projection - First angle and third angle projection of points. Projection of straight lines. Traces of lines.

UNIT-II

PROJECTIONS OF PLANES: Projections of plane figures: circle, square, rhombus, rectangle, triangle, pentagon and hexagon.

UNIT-III

PROJECTIONS OF SOLIDS: Projections of Cubes, Prisms, Pyramids, Cylinders and Cones Inclined to one plane.

UNIT-IV

ISOMETRIC PROJECTIONS: Isometric Projection and conversion of Orthographic views into isometric views. (Treatment is limited to simple objects only).

ORTHOGRAPHIC PROJECTIONS: Conversion of pictorial views into Orthographic views. (Treatment is limited to simple castings).

TEXT BOOKS

1. Engineering Drawing with AutoCAD by Dhananjay M. Kulkarni, Revised Edition, (PHI publication), 2010.
2. Engineering Drawing by N.D. Bhatt & V.M. Panchal, 53rd Edition,(Charotar Publishing House, Anand). (First angle projection) 2014.

REFERENCE BOOKS

1. Engineering Drawing by Dhananjay A Jolhe, 1st Edition,Tata McGraw hill publishers,2008.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	1										1	1	2
CO2	3	2	1										2	3	2
CO3	1	2	3										1	3	2
CO4	1	2	1										1	2	2

ENGINEERING CHEMISTRY LABORATORY

20MEL202/CYL01

Ist Year B. Tech. Second Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

LIST OF EXPERIMENTS

1. **Introduction to Chemistry Lab** (the teachers are expected to teach fundamentals like Calibration of Volumetric Apparatus, Primary, Secondary Solutions, Normality, Molarity, Molality etc. and error, accuracy, precision, theory of indicators, use of volumetric titrations).
2. **Volumetric Analysis:**
    a. Estimation of Washing Soda.
    b. Estimation of Active Chlorine Content in Bleaching Powder
    c. Estimation of Mohr's salt by permanganometry.
    d. Estimation of given salt by using Ion-exchange resin using Dowex-50.
3. **Analysis of Water:**
    a. Determination of Alkalinity of Tap water.
    b. Determination of Total Hardness of ground water sample by EDTA method
    c. Determination of Salinity of water sample
4. **Estimation of properties of oil:**
    a. Estimation of Acidic Value.
    b. Estimation of Saponification Value.
5. **Preparations:**
    a. Preparation of Soap
    b. Preparation of Urea-formaldehyde resin
    c. Preparation of Phenyl benzoate
6. **Demonstration Experiments (Any two of the following):**
    a. Determination of p^H of given sample.
    b. Determination of conductivity of given sample by conductometer.
    c. Potentiometric Determination of Iron.

TEXT BOOK:

1. Practical Engineering Chemistry by K.Mukkanti, Etal, B.S. Publicaitons, Hyderabad, 2009.
2. Inorganic quantitative analysis, Vogel, 5th edition, Longman group Ltd. London, 1979.

REFERENCE BOOKS:

1. Text Book of engineering chemistry by R.n.Goyal and HarrmendraGoel.
2. A text book on experiments and calculations- Engineering Chemistry. S.S. Dara.
3. Instrumental methods of chemical analysis, Chatwal, Anand, Himalaya Publications.

Course Outcomes:

1. Familiar with fundamental basics of Chemistry lab
2. Ability to estimate purity of washing soda, bleaching powder and quantity of Iron and other salts.
3. Gain the knowledge regarding the quality parameters of water like salinity, hardness, alkalinity etc.
4. Ability to prepare high polymers and soap.
5. Able to analyse the given oil for saphonification and iodine value.
6. Ability to understand the estimation of quality parameters by instrumentation technics.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2														
CO2	2	2	2	2		2						1			
CO3	2	2	2	2		2						1			
CO4	2	2	2	2								1			
CO5	2			2								1			
CO6	2	2	2	2								1			

ENGLISH COMMUNICATION SKILLS LABORATORY

20MEL203/ELL01

Ist Year B. Tech. Second Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

UNIT-I

1.1 Listening Skills; Importance – Purpose- Process- Types

1.2 Barriers to Listening

1.3 Strategies for Effective Listening

UNIT-II

2.1 Phonetics; Introduction to Consonant, Vowel and Diphthong sounds

2.2 Stress

2.3 Rhythm

2.4 Intonation

UNIT-III

3.1 Formal and Informal Situations

3.2 Expressions used in different situations

3.3 Introducing Yourself & Others-Greeting & Parting-Congratulating-Giving Suggestions & Advices-Expressing Opinions-Inviting People-Requesting-Seeking Permission-Giving Information- Giving Directions- Sympathizing- Convincing People-Complaining & Apologizing-Thanking Others- Shopping- Travelling-Conversational Gambits

UNIT-IV

4.1 JAM Session

4.2 Debates

4.3 Extempore

REFERENCE BOOKS:

- Communication Skills, Sanjay Kumar and PushpaLata. Oxford University Press. 2011
- Better English Pronunciation, J.D. O" Connor. Cambridge University Press:1984
- New Interchange (4rth Edition), Jack C Richards. Cambridge University Press: 2015v English Conversation Practice, Grant Taylor. McGraw Hill:2001

SOFTWARE:

- Buzzers for conversations, New Interchange series
- English in Mind series, Telephoning in English
- Speech Solutions, A Course in Listening and Speaking

Course Objectives

1. to comprehend the importance, barriers and strategies of listening skill in English.
2. to illustrate and impart practice Phonemic symbols, stress and intonation.
3. to practice oral skills and receive feedback on learners' performance.
4. to practice language in various contexts through pair work, role plays, group work and dialogue conversations.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1								3	4	4	4	3			
CO2										4	3	3			
CO3								3	4	4	3	3			
CO4								3	4	4	4	3			

WORKSHOP PRACTICE

20MEL204/MEL02

Ist Year B. Tech. Second Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To impart student knowledge on various hand tools for usage in engineering applications.
2. Be able to use analytical skills for the production of components.
3. Design and model different prototypes using carpentry, sheet metal and welding.
4. Make electrical connections for daily applications.
5. To make student aware of safety rules in working environments.

Course Outcomes: After completion of this course student should be able to:

CO 1 Make half lap joint, Dovetail joint and Mortise & Tenon joint

CO 2 Produce Lap joint, Tee joint and Butt joint using Gas welding

CO 3 Prepare trapezoidal tray, Funnel and T-joint using sheet metal tools

CO 4 Make connections for controlling one lamp by a single switch, controlling two lamps by a single switch and stair case wiring.

SYLLABUS:

1. Carpentry
   a. Half Lap joint
   b. Dovetail joint
   c. Mortise &Tenon joint
2. Welding using electric arc welding process/gas welding
   a. Lap joint
   b. Tee joint
   c. Butt joint
3. Sheet metal operations with hand tools
   a. Trapezoidal tray
   b. Funnel
   c. T-joint
4. House wiring
   a. To control one lamp by a single switch
   b. To control two lamps by a single switch
   c. Stair-case wiring

TEXT BOOKS:

1. P.Kannaiah and K.L.Narayana, Workshop Manual, SciTech Publishers, 2009.
2. K. Venkata Reddy, Workshop Practice Manual, BS Publications, 2008.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	3	2		2		2			1		2	1	2	3
CO2	2	3	2		2		2			1		2	1	2	3
CO3	2	3	2		2		2			1		1	1	2	3
CO4			2		2		2			1		1			2

MATHEMATICS - III
20ME301/MA03
II Year B. Tech. Third Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Outcome: After completion of the course students will be able to

CO1 Understand various continuous probability density functions and apply them to various problems in science and engineering.

CO2 Estimate the point and interval estimators of the mean, variance and proportion for the given Sample data and apply Z-test, t-test to various real life problems

CO3 Apply various sample tests like $\chi 2$ -test and F test for decision making regarding the population based on sample data to different realistic problems.

CO4 Compute the level of correlation, the linear relationship for the given bivariate data and the best fit curve to the given data by the method of least squares. Also perform multiple regression analysis to the regression model arising in the field of engineering.

UNIT – I

Probability Densities: Continuous Random Variables, The Normal Distribution, The Normal Approximation to the Binomial Distribution, The Uniform Distribution, The Gamma Distribution, The Beta Distribution, TheWeibull distribution, Joint Distributions-Discrete and Continuous.

(Sections 5.1, 5.2, 5.3, 5.5,5.7, 5.8, 5.9, 5.10 of the Text Book) [12 Hours]

UNIT – II

Sampling Distributions: Populations and Samples, The sampling distribution of the mean (σ known), The sampling distribution of the mean (σ unknown), The sampling distribution of the variance.
Inferences Concerning a Mean: Point estimation, Interval estimation, Tests of Hypotheses, Null Hypotheses and Tests of hypotheses, Hypothesis concerning one mean.

(Sections 6.1, 6.2, 6.3, 6.4, 7.1, 7.2, 7.4, 7.5, 7.6 of the Text Book) [12 Hours]

UNIT-III
Comparing Two Treatments: Comparisons-Two independent Large samples, Comparisons-Two independent small samples, Matched pairs comparisons.
Inferences Concerning Variances: The estimation of variances, Hypotheses concerning one variance, Hypotheses concerning two variances.
(Sections 8.2, 8.3, 8.4, 9.1, 9.2, 9.3 of the Text Book) [12 Hours]

UNIT –IV

Inferences Concerning Proportions: Estimation of proportions, Hypotheses concerning one proportion, Hypotheses concerning several proportions.

Regression Analysis: The method of least squares,Curvilinear regression, Multiple regression, Correlation.

(10.1, 10.2, 10.3, 11.1, 11.3, 11.4, 11.6 of theText Book) [12 Hours]

Text Book: Miller & Freund's "Probability and Statistics for Engineers", Richard A. Johnson, 8th Edition, PHI.

Reference Book: Probability & Statistics for Engineers and Scientists', 6th Edition, PHI, R.E Walpole, R.H. Myers & S.L. Myers.

CO-PO Mapping

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2		2									1		
CO2	3	2		2									3		
CO3	3	2		3									3		
CO4	2	2		3									2		

BASIC MANUFACTURING PROCESSES
20ME302
II Year B. Tech. Third Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives: After completion of the course the students will be able

1. To understand basic casting processes used in the manufacturing industry.
2. To learn various aspects of different advanced casting techniques and their applicability in the modern manufacturing industries.
3. To obtain a broad knowledge in different welding and joining techniques and their applications.
4. To calculate of power and design requirements in sheet metal and metal forming operations.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO 1 Recommend the particular casting process required to be selected for a specific engineering application.

CO 2 Design and model the required gating system for a given casting process.

CO 3 Select a specific welding process to minimize defects and to develop sound joint.

CO 4 Understand and design the metal working processes to produce wrought products.

UNIT-I

METAL CASTING: Introduction, advantages of casting method, pattern types, pattern materials and allowances.
(5)

SAND MOULDING: Moulding Procedure, moulding materials and equipment, types of sand, properties, preparation, control and testing of moulding sands.
(7)

UNIT-II

GATING DESIGN: Design Considerations and problems. (5)

SPECIAL CASTING METHODS: Permanent Mould Casting, Die Casting, Centrifugal casting, Investment casting, shell moulding, CO_2 process and continuous casting. Fettling of castings, casting defects: causes, remedies and testing. (7)

UNIT-III

WELDING: Gas and arc welding - Principles of oxy-acetylene welding, oxyacetylene flame cutting, MMAW (Manual metal arc welding), TIG, MIG, submerged arc welding. Resistance

welding principles - Butt welding, Spot welding, Seam welding. Thermit Welding, Electro slag welding. Laser beam welding. Brazing & Soldering, welding defects - causes and remedies. (12)

UNIT-IV

METAL WORKING PROCESSES: Introduction, Hot and Cold working of metals. Rolling, Forging, Extrusion, Tube making, Swaging, Spinning, Coining, Embossing and Wire drawing. (5)

SHEET METAL WORKING OPERATIONS: Introduction, Types of Sheet metal working operations, Blanking and Punching operations, Clearance and shear as applied to Punching/Blanking operations, Simple related problems, High energy rate forming of metals, Bending, deep drawing. (7)

TEXT BOOKS

1. Elements Of Workshop Technology Vol1 Manufacturing Process By S K Hajra Choudhury, (Author), Media Promoters (Publisher) 14th Edition, 2010.
2. Manufacturing Technology-Vol- I by P. N. Rao, TMH Publishers, 4th Edition, 2017

REFERENCE BOOKS

1. Manufacturing Engineering & Technology - Kalpakjian, Pearson Education / PHI, 7th Edition, 2013
2. Manufacturing Science - Amitabha Ghosh, Asok Kumar Mallik, Prentice Hall. 2nd Edition, 2010.
3. Principles of Metal Casting - Heine, Loper, Rosenthal, TMH, Publishers, 2nd Edition, 2017

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1	1							1	2		2	2	1
CO2	2		1	2				2		1	1		3	1	
CO3	3	2	1							1			2		2
CO4	3		2					1		2			2	2	

Strength of Materials
20ME303
II Year B. Tech. Third Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment	:	30	Semester End Examination (3 Hours)			:	70

Prerequisites: None

Objective: The objective of the course is to provide basic knowledge to analyze the various structural members subjected to axial, torsional and bending loads with respect to stresses, strains and deflections in order to facilitate design of members of structures.

Course Outcomes:

After undergoing this course the student should be able to

CO 1 Understand the basic terms used in this course and be in a position to calculate the stresses and strains in determinate and indeterminate axially loaded members.

CO 2 Determine the diameter of a shaft when it is transmitting certain power keeping in mind the stresses and deformations produced and also draw the S.F. and B.M. diagrams for statically determinate beams.

CO 3 Calculate the stresses, strains and deflections of various types of beams.

CO 4 Determine the principal and maximum shear stress in a member when it is in plane stress and find the buckling loads for long columns with different end connections.

UNIT-I

TENSION, COMPRESSION AND SHEAR: Introduction to Mechanics of materials, normal stress and strain, stress strain diagram for mild steel, elasticity and plasticity, linear elasticity, Hooke's law and Poisson's ratio, shear stress and strain and their sign conventions, allowable stresses and allowable loads. (7)

AXIALLY LOADED MEMBERS: Introduction, changes in lengths of axially loaded members (including bars with varying loads and dimensions), Statically indeterminate structures– Flexibility method. (5)

UNIT-II

TORSION: Introduction, torsion of circular bars, non-uniform torsion, transmission of power by circular shafts. (5)

SHEAR FORCE AND BENDING MOMENT: Introduction, Types of Beams, Loads and Reactions. Shear force and bending moment, relationships between load, Shear force and bending moment, S.F. and B.M. diagrams for loads other than varying loads. (7)

UNIT-III

STRESSES IN BEAMS: Introduction, longitudinal strains and normal stresses in beams (flexural formula) (5)

DEFLECTIONS OF BEAMS: Introduction, Differential Equations of the Deflection Curve, Deflections by Integration of the Bending Moment Equation, Moment Area Method, Macaulay's Method. (7)

UNIT-IV

ANALYSIS OF PLANE STRESSES: Introduction, plane stress, stresses on inclined sections, principal stresses and maximum shear stresses, Mohr's circle for plane stress, Hooke's law for plane stress. (7)

COLUMNS: Introduction, concept of elastic stability, end conditions, Euler's theory for Columns with different end supports, Limitations of Euler's Formula, Rankine's Formula. (5)

TEXT BOOKS

1. 'Mechanics of Materials' by James M Gere and Barry J Goodno, Enhansed 9th Edition, Cenegage Publishers, 2020.
2. 'Strength of Materials' by Dr. Sadhu Singh, 1st Edition, Khanna Publishers, 2016.

REFERENCE BOOKS

1. 'Mechanics of Materials' by Ferdinand J. Beer, Russell E. Johnston Jr, 8th Edition (in SI Units), Mc Graw Hill Publications, 2020.
2. 'Strength of Materials' by L. S. Srinath, Macmillan Publishers, 2000.
3. 'A text book of Strength of Materials' by R K Rajput, 7th Edition, S Chand Publications, 2018.
4. 'A text book of Strength of Materials' by R K Bansal, 6th Edition, Laxmi Publications, 2022.

CO-PO MAPPING

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2		2								3	2	
CO2	3		2		3								3	2	
CO3	3		2		3								3	2	
CO4	3		2		2								3	2	

ENGINEERING THERMODYNAMICS
20ME304/ES
II Year B.Tech(Mech) Third semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:
To make the students:

1. To Understand the fundamental concepts and laws of thermodynamics.
2. To apply the laws of Thermodynamics.
3. To Understand the Concepts of Entropy and Availability.
4. To demonstrate the Gas power cycles and IC Engines.

Course Outcomes:
Upon successful completion of the course, the student will be able

CO 1 To discuss the fundamental concepts and laws of thermodynamics.
CO 2 To illustrate the application of laws of Thermodynamics.
CO 3 To describe the Concepts of Entropy and Availability.
CO 4 To describe the Gas power cycles and IC Engines.

UNIT-I
FUNDAMENTAL CONCEPTS AND DEFINITIONS: Introduction, Macroscopic and microscopic points of view, Thermodynamic system and control volume, Perfect gases, properties and state of a substance, Thermodynamic equilibrium and Quasi-static Process, Thermodynamic path, cycle, Path function and Point function, Internal energy and Enthalpy work and heat, Displacement work, Displacement work in various Quasi-Static processes, Forms of Work transfer. (8)

LAWS OF THERMODYNAMICS: zeroth law of thermodynamics, first law of thermodynamics and second law of thermodynamics (4)

UNIT-II
FIRST LAW OF THERMODYNAMICS: First law of thermodynamics for a closed system undergoing a cycle and a change of state, Energy- A property of the system, First law analysis for a closed system (Non-flow processes). Steady flow energy equation and its application to engineering equipment, Limitations of first law of thermodynamics, PMM of first kind. (6)
SECOND LAW OF THERMODYNAMICS: Heat engines and Refrigerators, Statements of Second law, PMM of second kind, reversible and irreversible processes, factors that render a process irreversible, Carnot cycle, Carnot theorem and its corollaries, Thermodynamic temperature scale. (6)

UNIT-III
ENTROPY: Inequality of Classius, Entropy change in reversible process, T-ds relations, Entropy change of a system during an irreversible process, Principle of increase of entropy, Applications, Entropy change of an ideal gas. (7)

AVAILABILITY AND IRREVERSIBILITY: Available and unavailable energy, Helmholtz & Gibb's function, Availability Function for a non-flow Process, Availability Function of Flow Processes, Irreversibility. (5)

UNIT-IV

GAS POWER CYCLES: Otto cycle, Diesel cycle, Dual cycle, Comparison of Otto, Diesel and Dual cycle. Brayton cycle. (7)

INTERNAL COMBUSTION ENGINES: Introduction, Basic engine nomenclature, Classification, Working of SI and CI engines (Both 4-stroke and 2-stroke engines). (5)

TEXT BOOKS

1. Engineering Thermodynamics by P.K.Nag, TMH Publications, 6th Edition, 2017.
2. A Textbook Of Engineering Thermodynamics by R.K Rajput, Laxmi Publications , 5th Edition, 2016.

REFERENCE BOOKS

1. Engineering Thermodynamics by M. Achuthan , PHI Publications, 2nd Edition, 2009.
2. Thermal Science and engineering by D.S.Kumar, Kataria & Sons Publications, 4th Edition. 2020.
3. Thermodynamics - An Engineering Approach by Yunus A. Cengel , Michael A. Boles, Mehmet Kanoglu TMH Publications,9th Edition, 2019.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1					2							1		
CO2	2	2		1			1						1	2	
CO3	2	1					1						1	2	
CO4	2	2	1			1	1						1	2	

FLUID MECHANICS & HYDRAULIC MACHINES
20ME305
II Year B.Tech. (Mech) Third Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:
To make the students to
1. Interpret the properties of fluids, fluid statics and kinematics.
2. Discuss dynamics of fluid flow and pipe flow.
3. Explain impact of jets and hydraulic turbines.
4. Demonstrate the working of reciprocating and centrifugal pumps

Course Outcomes:
After completion of the course the student will be able to:
CO 1 Describe the static and kinematics of fluid flow.
CO 2 Demonstrate dynamics of fluid flow and analyse pipe flow
CO 3 Analyse the impact of jets on vanes and hydraulic turbines.
CO 4 Illustrate the working principles of reciprocating and centrifugal pumps

UNIT-I
INTRODUCTION: Definition of fluid, Properties of a fluid – density, specific weight, specific gravity, viscosity, compressibility, surface tension, capillarity, vapor pressure, Classification of fluids. (2)

FLUID STATICS: Pressure, variation of pressure in a fluid, measurement of pressure – simple and differential manometers, pressure head, Pascal's law, Total pressure and center of pressure on plane surfaces, Introduction to Buoyancy and Metacentric height. (5)

FLUID KINEMATICS: Velocity and acceleration of fluid particle, types of fluid flow, Description of flow pattern, velocity potential, stream function, flow net, continuity equation in Cartesian coordinates. (5)

UNIT-II
FLUID DYNAMICS: Introduction, Euler's equation of motion, Bernoulli's equation, Pitot tube, venturimeter, Introduction to orifice- various coefficients of an orifice. Impulse momentum Principle, Equation and Application - Force on pipe bend. (6)

FLOW THROUGH PIPES: Reynolds experiment, Darcy-Wiesbach equation, minor losses, pipes in series and parallel, transmission of power through a pipe, water hammer. (6)

UNIT-III

IMPACT OF JETS: Introduction, angular momentum principle, Force exerted by a fluid jet on stationary and moving flat plate and curved vanes, flow over radial curved vanes. (6)

HYDRAULIC TURBINES: Classification of turbines, Heads and efficiencies of a turbine, , Pelton, Francis and Kaplan turbines- Working, proportions of turbines, Introduction to draft tube theory, unit quantities, Specific speed. (6)

UNIT-IV

RECIPROCATING PUMPS: Types, Working principle, Power required by a Reciprocating pump, Coefficient of discharge, Slip and negative slip, Effect of Acceleration of piston on velocity and pressure in suction and delivery pipes, Indicator diagram, Maximum speed of a reciprocating pump. Introduction to Air vessels. (6)

CENTRIFUGAL PUMPS: Types, Working, Reciprocating vs. Centrifugal pump, Work done by impeller, Head of a pump, losses and efficiencies, Minimum starting speed, Specific speed, Multistage pumps, Pumps in parallel, Cavitation (6)

TEXT BOOKS

1. Hydraulics and Fluid Mechanics Including Hydraulics Machines -P.N. Modi & S.M.Seth, Standard Book House, 22nd Edition, 2019
2. Fluid Mechanics and hydraulic machines-R.K.Bansal, Laxmi Publications, 10th Edition, 2019.

REFERENCE BOOKS

1. Fluid mechanics and fluid power engineering - D.S.Kumar, SK Kataria& Sons, 2013 Edition.
2. Engineering Fluid Mechanics- K.L.Kumar, S.Chand Publications, Reprint Edition 2006

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	1	1		1	1						2	2	
CO2	2	3	1	2		2	2						2	2	
CO3	2	3	1	2		2	2						2	2	
CO4	2	2	2	1		2	1						2	1	

MACHINE DRAWING LAB
20MEL301
II Year B. Tech. (Mech) Third Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:
To make the students
1. To understand the different commands in the drafting module of CAD software
2. To create sectional views of machine parts
3. To model the 2D part drawing of machine components.
4. To generate the 2D assemblies of machine components

Course Outcomes:

After completing the course, the student should be able to:

CO 1 Execute steps required for 2D modelling.
CO 2 Use of dimensioning of part models.
CO 3 Sketch the parts of machine components.
CO 4 Develop the assemblies of various machine components.

Course Content: 2D Drafting using any of the modelling packages
List of Exercises
1. Sectional views
2. Drafting of knuckle joint
3. Drafting of Universal coupling
4. 2D part drawing of machine components
5. 2D assemblies of machine components

TEXT BOOKS

1. A Text book of "Machine Drawing" by K. L. Narayana, P. Kannaiah, K. Venkata Reddy New Age International (P) Ltd., Publishers; Sixth edition, 2019.
2. Engineering Drawing by N.D. Bhatt & V.M. Panchal. Charotar Publishing House Pvt Ltd., Fifty Third edition, 2014.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2												2	
CO2	2	1												2	
CO3	2	2												2	
CO4	2	2												1	

STRENGTH OF MATERIALS & FLUID MECHANICS LAB
20MEL302
II Year B. Tech. Third Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. 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

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

Course Outcomes:

After completion of the course student will be able to

CO 1 Determine the mechanical properties like tensile strength, hardness and impact test under various conditions
CO 2 Measure discharge in pipes and identification of type of flow.
CO 3 Verify the Bernoulli's equation and determine energy loss in conduits
CO 4 Evaluate the characteristics of turbines and pumps

LIST OF EXPERIMENTS:

Strength of Materials Lab

1. Determination of shear strength on mild steel bar using UTM.
2. Find young's modulus using simply supported beam on steel and wood.
3. Find young's modulus using cantilever beam on steel.
4. Calculate rigidity modulus for the spring by using deflection formula.
5. Evaluate shear modulus by conducting torsion test on a mild steel bar.
6. Charpy test.
7. Conduct hardness tests (B.H.T & R.H.T.) on steel and brass specimens.
8. Tension test on U.T.M. to find elastic properties.

Fluid Mechanics Lab

1. Verification of Bernoulli's theorem
2. Venturi meter Determination of coefficient of discharge
3. Determination of friction factor for pipes of different materials
4. Determination of loss of head in pipes due to bends, sudden contractions and sudden expansion.
5. Measurement of force due to impact of jets on vanes of different types.
6. Performance study on Pelton turbine
7. Performance studies on single acting reciprocating pump

8. Performance studies on single stage centrifugal pump

Note: A minimum of 6 experiments shall be done and recorded from each lab.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	3									2	2	1
CO2	2	1	3	2									2	2	1
CO3	2	2	2	3									2	2	1
CO4	2	2	3	2									2	1	1

BASIC MANUFACTURING PROCESSES LAB

20MEL303

II Year B. Tech. (Mech) -III Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objective:

Basic Manufacturing Lab includes experiments in the areas of foundry, patternmaking, fitting and operations on lathe machines. Preparation of wooden pattern using carpentry tools and making sand mold using pattern enables the student to know the necessity of pattern, mold during the preparation of casting. Basic machining operations carried out using lathe machines equip the student's practical knowledge on machining of metals.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO 1 Prepare sand mould for different components using simple patterns.

CO 2 Acquire knowledge on several fits and prepares different types of fitting joints.

CO 3 Acquires practical knowledge on basic machining operations and can machine metals using lathe machines by selecting appropriate machining operation.

CO 4 Prepare threads on a given surface of metallic rods

Experiments

1. Paring sand mould of stepped cone pulley
2. Preparing sand mould of hand wheel
3. Preparing sand mould of bush.
4. Cutting MS plate and preparing V-joint
5. Cutting MS plate and preparing square joint
6. Cutting MS plate and preparing dovetail –joint
7. Plain turning, facing and chamfering of an MS rod.
8. Step turning of an MS rod
9. Taper turning of an MS rod
10. Right –hand and left-hand thread cutting on an MS rod

11. Eccentric turning of an MS rod

12. Knurling and counter turning of an MS rod.

TEXT BOOKS

1. Elements Of Workshop Technology Vol1 Manufacturing Process By S K Hajra Choudhury, (Author), Media Promoters (Publisher) 14th Edition, 2010.
2. Manufacturing Technology-Vol- I by P. N. Rao, TMH Publishers, 4th Edition, 2017

REFERENCE BOOKS

1. Manufacturing Engineering & Technology - Kalpakjian, Pearson Education / PHI, 7th Edition, 2013
2. Manufacturing Science - Amitabha Ghosh, Asok Kumar Mallik, Prentice Hall. 2nd Edition, 2010.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1			1									1	1	1	1
CO2	1	1										1	1		
CO3	1	1	1									1	1	1	
CO4	1	1	1	1	1							1		2	

PNEUMATIC & HYDRAULIC DRIVES LAB
20ME307/SO

II Year B. Tech. Third Semester

Lectures	0	Tutorial	1	Practical	2	Credits	2
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To understand the importance and applications of fluid power in industrial automation.
2. To get familiarized with the theoretical concepts like the process of power generation, transmission, and control of hydraulic and pneumatic drives.
3. To identify and select different components used in fluid power circuits.
4. To build Pneumatic and Hydraulic circuits for different applications and trouble shoot them.

Course Outcomes:

Upon Completion of the course the student will be able to

CO 1 Understand the basic principles and applications of different components of pneumatic and hydraulic systems and identify the common hydraulic and pneumatic components, their uses and symbols.

CO 2 Conduct experiments to identify pressure intensification and flow characteristics of single rod hydraulic cylinder. Assemble electrohydraulic circuits for hydraulic motor and check valve to know their applications in hydraulic drive systems.

CO 3 Build and operate pneumatic circuits to gain knowledge about different actuation methods, speed regulation and position-time-pressure control.

CO 4 Design and operate electro pneumatic circuits to perform experiments on AND, OR, Latching and signal overlapping functions.

THEORY

Overview of Fluid power: Introduction, Fluid Power, Basic Law, Application of Fluid Power, Advantages of Fluid Power Systems, Types of Fluid Power Systems. Hydraulic Systems: Pumps – Gear Pumps and Vane Pumps. Selection and Specification of Pumps. Hydraulic Actuators: Linear and Rotary Actuators. Control and Regulation Elements: Pressure, Flow and Direction Control Valves. Maintenance of Hydraulic Systems, Trouble Shooting of Hydraulic System. Introduction to Pneumatic Systems: Pneumatic fundamentals, Pneumatic Components and Pneumatic Circuits.

LIST OF EXPERIMENTS

Hydraulics

1. Pressure intensification of a single rod cylinder
2. Flow characteristics of a single rod cylinder
3. Characteristics of a Hydraulic motor
4. Working of a Hydraulic accumulator
5. Application of a check valve with manual operations

Pneumatics

1. Direct control, indirect control and speed regulation of a double acting cylinder.
2. Displacement, pressure and time dependent control of a double acting cylinder.
3. Basic circuits with AND function, OR function and electric latching.
4. Sequential control of 2 double-acting cylinders without signals overlapping.
5. Sequential control of 2 double-acting cylinders with signals overlapping.

TEXT BOOKS

1. Andrew Parr, “Pneumatics and Hydraulics", Jaico Publishing House,1999.
2. Antony Esposito, "Fluid power with Applications", Sixth edition- Pearson education, 2000

REFERENCE BOOKS

1. W.Bolton,” Pneumatic and Hydraulic systems” Butterworth-Heinemann
2. Practice for professional‘s pneumatics trainee‘s manual-BOSCH-REXROTH.
3. Practice for professional‘s electro pneumatics trainee‘s manual-BOSCHREXROTH.
4. Project manual on industrial hydraulics-BOSCH-REXROTH

WEB PAGE REFERENCES

1. https://www.grc.nasa.gov/www/k-12/WindTunnel/Activities/Pascals_principle.html
2. http://www.vickers.sh.cn/pdfs/M-SRSR-MC001-E.pdf
3. http://file.seekpart.com/keywordpdf/2011/3/31/20113319837232.pdf
4. http://www.associatedgroups.com/EATON-CAT/pdfs/i3155s.pdf

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1								1				1		
CO2	1								1				1		
CO3	1								1				1		
CO4	1								1				1		

Professional Ethics and Human Values
20ME308/MC
II Year B. Tech.Third Semester

Lectures	2	Tutorial	0	Practical	0	Credits	0
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			0

Course Objectives:

1. To Understand the human values of professionals
2. To study the Engineering Ethics and uses of ethical theories
3. To know the safety and risk
4. To deal with Global issues and to familiarize with Code of Ethics of several professional bodies

Course Outcomes:
Upon successful completion of the course, the student will be able

CO 1 To apply ethics and Human Values in their professional career

CO 2 To deal with various Variety of moral issues and Moral dilemmas

CO 3 To know the problems encountered with Engineering Experimentation.

CO 4 To realize various global issues and also to familiarize with the responsibilities of professional societies.

Unit I

Human Values: Morals, Values and Ethics, Integrity, Work Ethic, Civic Virtue, Respect for others, Caring, Sharing, Honesty, Valuing time, Empathy, Self Confidence, Character, Professionalism

(6)

UNIT-II

Engineering Ethics: Senses of Engineering Ethics, Variety of Moral Issues, Types of Inquiry, Moral Dilemmas, Moral Autonomy, Kohlberg ‘s Theory, Gilligan ‘s Theory (6)

UNIT-III

Engineering as Social Experimentation: Engineering as Experimentation, Engineers as Responsible Experimenters, Safety, Responsibility and Rights: Safety and Risk – Assessment of Safety and Risk, Risk Benefit Analysis and Reducing Risk.

(6)

UNIT-IV

Global Issues: Multinational Corporations, Environmental Ethics, Computer Ethics, Weapon Development,

Sample codes of Ethics like ASME, IEEE, and Institution of Engineers(India)

(6)

TEXT BOOKS

1. Govindarajan. M, Natarajan. S, Senthilkimar.V.S, Engineering Ethics, PHI, 2004.
2. M.P.Raghavan, Professional Ethics and Human Values, Scitech Publications(India)Pvt.ltd., 2009.

REFERENCE BOOKS

1. Mike Martin and Roland Schinzinger, Ethics In Engineering, McGraw Hill, New York 1996.
2. Charles D Fleddermann, Engineering Ethics, Prentice Hall, New Jersey, 2004

CO - PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1						1		1	2	1					
CO2						1	1	3	2	2	1				
CO3						3	1	1		1	2				
CO4						2	3	1	2	1	2				

MATERIALS ENGINEERING
20ME401/BS
II Year B. Tech.Fourth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To familiarize with the basic meaning of crystalline and non-crystalline materials with a detailed understanding of crystal imperfection of alloys and compounds and their applications in engineering fields
2. To describe phase diagrams and phase transformations in the binary alloys and the iron-iron carbide system with the basic classification of steels and cast irons.
3. To describe different heat treatment routes to modify the properties of steels and to introduce the composite materials classification and applications
4. To give an introduction to powder metallurgy and other advanced materials.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO 1 Describe and recommend the material type required to be selected for a specific engineering application.

CO 2 Understand and calculate the phases and their relative amounts present in a given phase diagram and determine the material behavior with respect to its constituting phases.

CO 3 Select a suitable heat treatment or strengthening route to alter the mechanical behavior of structures made of steels.

CO 4 Understand and compare the performance of different modern engineered materials such as composite materials, powder metallurgy components and nano materials.

UNIT-I

CRYSTALLOGRAPHY: Basic material properties, classification of materials, crystalline and non-crystalline materials, classification of crystals – Bravi's lattices – Packing factor and coordination number in simple cubic, BCC, FCC and HCP systems –– Miller indices for planes and directions, crystal imperfections – crystal deformation – Slip and Twinning.
(8)

CONSTITUTION OF ALLOYS: Introduction to alloys and compounds, solid solutions, Hume-Rothery principles, compounds, electron compounds
(4)

UNIT-II

PHASE DIAGRAMS: Gibb's Phase rule – one component system, two component system, Phase transformations - isomorphous, eutectic, peritectic systems. Phase transformations in solid state: eutectoid and peritectoid systems.
(5)

STEELS AND CAST IRONS: Iron–Iron carbide equilibrium diagram and phase transformations, Cast irons: classification of cast irons (5)

ISOTHERMAL TRANSFORMATINS: TTT diagrams for eutectoid, hypo and hyper eutectoid steels, martensite and bainitic transformations (2)

UNIT-III

HEAT TREATMENT OF STEELS: Annealing, normalizing, hardening, tempering, age hardening, austempering, martempering and hardenability concept and experimental determination. (5)

SURFACE HARDENING: carburizing, nitriding, cyaniding, flame hardening and induction hardening. (5)

STRENGTHENING MECHANISMS: Strain hardening, solid solution strengthening, grain refinement, dispersion strengthening. (2)

UNIT-IV

COMPOSITE MATERIALS: Properties and applications of Particulate-reinforced composites, fibre reinforced composites, Laminar composites and metal matrix composites. (5)

POWDER METALLURGY: Powder metallurgy process, preparation of powders, characteristics of metal powders, mixing, compacting, sintering, Applications of Powder Metallurgy. (5)

ADVANCED MATERIALS: Introduction to Nanomaterials, biomaterials, smart materials, non-ferrous metals and their alloys: Brief study of copper and aluminium alloys, properties and applications. (2)

TEXT BOOKS

1. Introduction to Physical Metallurgy - Sidney H. Avner, McGrawHill, 2nd Edition, 2017.
2. Material Science and Metallurgy - V. Raghavan, Pearson Education / PHI, 5th Edition, 2011.

REFERENCE BOOKS

1. Material Science and Metallurgy - V. D. Kodgire, Everest Publishers, 39th Edition, 2017.
2. Material Science and Metallurgy - R. B. Choudary - Khanna Publications.1st Edition, 2015.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3		2		1			2			1		2		2
CO2	2		1					2					3	1	2
CO3	3	2	1		2			1					2		1
CO4	3		1					1			2		3	1	

METAL CUTTING AND MACHINE TOOLS
20ME402
II Year B.Tech. (Mech) Fourth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To describe the primary and auxiliary motions in machine tools and parameters defining them.
2. To provide fundamental knowledge regarding working principle, classification, parts, mechanisms and operations performed on various machine tools.
3. To provide basic information regarding formation of chip and its types in metal cutting.
4. To establish relation between shear angle, chip thickness ratio, stress and strain in the chip and cutting forces.
5. To provide information regarding geometry of single point cutting tool, tool materials and their application.
6. To provide information about heat generation, temperature distribution and application of cutting fluids in metal cutting.

Course Outcomes:

At the end of the course, the student will be able to:

CO 1 Describe the parts, mechanisms, selection of cutting parameters and operations that can be done on a lathe machine.

CO 2 Describe the parts, mechanisms and operations that can be done on drilling, shaping, planing and grinding machines.

CO 3 Explain the construction, types and operations that can be done on a milling machine. Also discuss about milling cutters and methods of indexing.

CO 4 Discuss about tool geometry, chip formation and heat generation in metal cutting. Also calculate shear angle, stress, strain, velocities and cutting forces in metal cutting.

UNIT-I

MACHINING PROCESSES AND MACHINE TOOLS: Introduction, Primary and Auxiliary Motions in Machine Tools, Parameters defining working motions of a Machine Tool. (4)

LATHE: Constructional details, specifications, classification of lathes**.**
Lathe Mechanisms: Spindle speed Mechanisms in Belt driven and All Geared Head stock, Apron and Half-nut mechanisms. Lathe accessories – various work holding devices. Lathe operations including taper turning and thread cutting and related problems. (8)

UNIT-II

DRILLING MACHINES: Types of drilling machines and specifications, drilling operations, drilling time. (3)

SHAPING AND PLANING MACHINES: Constructional details, types of shapers and planers, specifications, Quick Return Mechanism and automatic feed mechanisms, operations done on these machines. (3)

GRINDING MACHINES: General Principles, Types of grinding machines, Wheel materials, Selection and specification of grinding wheels, Truing and Dressing of grinding wheels. (6)

UNIT-III

SURFACE FINISHING OPERATIONS: Honing and Lapping operations. (2)

MILLING MACHINES:

Working Principle, Size and Specification, Types of milling machines, Description and working of Universal Milling machine, Up and Down Milling, Milling operations, Milling cutters, Indexing methods and Indexing Head, related problems.
(10)

UNIT-IV

THEORY OF METAL CUTTING:

Introduction, Basic elements of machining, Nomenclature of single point cutting tool, Tool Geometry, Mechanics of chip formation, Types of chips. Determination of shear angle and chip thickness ratio, stress and strain in the chip, velocity relations, Merchant's theory of orthogonal cutting forces, related simple problems. (6)

Tool wear, Tool life and Tool life criteria (2)

Heat Generation and temperature distribution in metal cutting , cutting fluids- types and required characteristics. (2)

CUTTING TOOL MATERIALS: Requirements of tool materials and types. (2)

TEXT BOOKS

1. Workshop Technology Vol. II:Machine Tools by S.K. Hajra Choudhury, MPP Pvt.Ltd, 15th Edition, 2010
2. A Text Book of Production Engineering by P.C. Sharma, S.Chand& Co, Reprint 2019 Edition.

REFERENCE BOOKS

1. Manufacturing Science - Amitabha Ghosh, Ashok Kumar Mallik, Prentice Hall. 2nd Edition, 2010.
2. Machining and machining process by PN.Rao, TMH Publications, 4th Edition, 2017.
3. Manufacturing Engineering & Technology - Kalpakjian, Pearson Education / PHI, 7th Edition, 2013

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1	1	1			1	1				1		1
CO2	2		1	1	1			1	1				1		1
CO3	2		1	1	1			1	1				1		1
CO4	3	1		1	2		1	1	2		1		2	1	1

KINEMATICS OF MACHINES
20ME403
II Year B.Tech. Fourth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To understand the concept of machines, mechanisms, related terminologies
2. To analyse a mechanism for displacement, velocity and acceleration
3. To develop cam profiles for specified motions
4. To understand the theory of gears, gear trains

Course Outcomes:

Upon Completion of the course the student will be able to

CO 1 Understand and apply the fundamental concepts of kinematics of machines.

CO 2 Carry out the velocity and acceleration analysis of various mechanisms.

CO 3 Locate instantaneous centers for a mechanism and achieve the complicated output motions with the help of cams.

CO 4 Understand kinematics of gears and gear trains.

UNIT-I

Introduction:
Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Classifications of Kinematic pairs, Types of constrained motions, Degrees of Freedom, kinematic-chain, Linkage, Mechanism and structure, Classification of mechanisms, Inversions of a mechanism, Inversions of Four –Link (bar)chain, Single Slider - Crank Chain, Double – Slider Chain. (12)

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UNIT-II

Velocity Analysis:
Introduction, Absolute and Relative Motion, Vectors, Addition and subtraction of Vectors, Motion of a Link, Four Link Mechanism, Angular Velocity of Links, Velocity of Rubbing, Slider - Crank Mechanism, Crank and Slotted Lever Mechanism (6)

Acceleration analysis:
Acceleration, Four-Link Mechanism, Angular acceleration of Links, Acceleration of Intermediate and offset points, slider-Crank Mechanism, Coriolis acceleration component, Crank and slotted lever Mechanism. (6)

UNIT-III

Instantaneous Centre:
Notation, Number of Instantaneous Centres, Kennedy's theorem, Locating Instantaneous Centres, determination of angular velocity by of links by Instantaneous Centre Method. (5)

Cams:
Introduction, Types of cams, Types of Followers, Terminology – Types of follower motion: Uniform velocity, Simple harmonic motion and uniform acceleration and retardation, Graphical synthesis of cam profile (Knife Edge, Roller and Flat faced Followers). (7)

UNIT-IV

Gears:
Introduction, Classification gears, terminology, Law of Gearing, Velocity of Sliding, Forms of Teeth, Cycloidal Profile Teeth, Involute Profile Teeth, Path of contact, Arc of contact, Number of pairs of Teeth in contact, Interference in Involute Gears, Minimum number of Teeth, Comparison of Cycloidal and Involute tooth forms. (6)

Gear Trains:
Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train using Tabular Method. (6)

TEXT BOOKS

1. Theory of Machines by S.S.Rattan, McGraw Hill Education, 5th edition, 2019
2. Theory of Mechanisms and Machines by C.S.Sharma and Kamlesh Purohit, Prentice Hall India Learning Private Limited, 1st edition, 2006

REFERENCE BOOKS

1. Theory of Mechanisms and Machines by A. Ghosh and A. K. Mallik, East West Press Private Ltd., 3rd edition, 2008
2. Theory of Machines and Mechanisms by Mechanism and Machine Theory by J. J.Uicker, G. R. Pennock and J. E.Shigley, Oxford University Press,5th edition, 2017

Course	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		2		1								3	2	
CO2	3		2		3								3	2	
CO3	3		2		2								3	2	
CO4	2		2		2								2	2	

APPLIED THERMODYNAMICS
20ME404
II Year B.Tech Fourth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:
To make the students:

1. To understand the phase diagrams and describe the vapour power cycles.
2. To demonstrate the working principles of boilers and steam nozzles.
3. To illustrate the working of steam condensers and steam turbines.
4. To describe the different Refrigeration systems, psychrometry and air conditioning.

Course Outcomes:

On successful completion of the course, the student will be able to,

CO 1 Explain the properties of steam and apply them to vapour power cycles.
CO 2 Explain the working principles of boilers and steam nozzles.
CO 3 Distinguish and analyze the steam condensers and steam turbines.
CO 4 Discuss the working of Refrigeration systems and to apply psychometric process to analyze the various air conditioning systems.

UNIT-I

PURE SUBSTANCE: Definition, process of steam generation, P-v, T-s and h-s diagrams, properties of saturated and superheated steam, Use of Steam Tables, Mollier chart. (6)

VAPOR POWER CYCLES: Rankine cycle, Effect of pressure and temperature on the Rankine cycle, reheat cycle, regenerative cycle. (6)

UNIT-II

STEAM BOILERS: Function, classification, working of Babcock and Wilcox boiler, Cochran boiler, Mountings & Accessories. (6)

STEAM NOZZLES: Types of nozzles, Isentropic flow through nozzles, Effect of friction, Nozzle efficiency, Critical pressure ratio and maximum discharge, calculation of throat and exit areas using Mollier diagram. (6)

UNIT-III

STEAM CONDENSERS: Jet and Surface condensers, condenser vacuum and vacuum efficiency, Condenser efficiency, Thermodynamic analysis. (3)

STEAM TURBINES: Types of steam turbines, **Impulse turbines:** pressure and velocity compounding, velocity diagrams, work output, power, blade efficiency and stage efficiency. **Reaction turbines:** velocity diagrams, degree of reaction, work output, power, blade efficiency and stage efficiency. Governing of turbines, Overall efficiency and reheat factor. (9)

UNIT-IV

REFRIGERATION: Need for Refrigeration, Definitions, Methods of refrigeration, Bell Coleman cycle, Refrigerating effect, COP, Vapor compression refrigeration system, Influence of

various parameters on cycle performance, Vapor absorption refrigeration cycle

(6)

PSYCHROMETRY AND AIR CONDITIONING: -Introduction, Psychrometric properties, Psychrometric chart, Psychrometric processes, Types of Air conditioning systems.

(6)

TEXT BOOKS

1. Thermal Engineering by R.K Rajput, Laxmi Publications, New Delhi 10th Edition,2020
2. Thermal engineering by Mahesh M Rathore, TMH publications,2nd Edition,2010

REFERENCE BOOKS

1. Thermodynamics - An Engineering Approach by Yunus A. Cengel , Michael A. Boles, Mehmet Kanoglu TMH Publications,9th Edition, 2019.
2. Refrigeration and Air Conditioning by C.P.Arora, TMH Publications ,3rd Edition, 2017.
3. Engineering Thermodynamics by M. Achuthan , PHI Publications, 2nd Edition, 2009.
4. Thermal Science and engineering by D.S.Kumar, Kataria & Sons Publications, 4th Edition. 2020.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	1				1	1						2	1	
CO2	2	1		1		1	1						2	1	
CO3	2	2	2	1		1	1						2	1	
CO4	2	1	2	2		2	1						1	2	

INDUSTRIAL ENGINEERING AND MANAGEMENT
20ME405
II Year B.Tech. (Mech) Fourth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To develop the skills of the student in Industrial Engineering such as productivity, Work Study.
2. To provide the working knowledge of management, organization, and Human Resource Management.
3. To imbibe the knowledge of Marketing Management and Financial Management.
4. To make the student develop the skills of decision making with regard to Materials Management and Quality Management.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Solve the problems of productivity and Work Study.
CO2: Understand concepts of management, organisation structures and Human Resource Management.
CO3: Illustrate the concepts of Marketing Management and Financial Management.
CO4: Compute the problems of Materials Management and Quality Management for its implementation in the industry.

UNIT-I

Industrial Engineering: Objective, Need and Scope of Industrial Engineering. (3)

Productivity: Introduction, methods to measure productivity, measures to improve productivity. (3)

Work Study – Definition, objectives and uses; Method study – Definition, objectives, procedure and uses; Time study – Definition, need, functions, and basic concepts of break down. (6)

UNIT-II

Management: Introduction, Levels of management, Evolution of management thought: Taylor's Scientific Management, Functions of management. (3)

Organisation: Introduction to organization, principles and types of organization structures. (3)

Human Resource Management: Functions of HR management, human resource planning, leadership styles, performance appraisal, Motivation Theories. (6)

UNIT-III

Marketing Management: Introduction, Marketing Vs Selling, marketing mix, distribution channels, and product life cycle based marketing strategies. (6)

Financial Management: Scope, objectives and functions of Financial Management**;** Reading Profit & Loss account and Balance sheet; Working Capital Management*:* Concepts and Objectives. (6)

UNIT-IV

Materials Management: Inventory Control, Inventory costs, Basic EOQ model, Model with Price breaks, P and Q systems, ABC analysis. (6)

Quality Management: Importance of quality, Difference between Inspection and Quality control, Components of total quality, Acceptance sampling, Introduction to Taguchi methods (6)

TEXT BOOKS

1. Industrial Engineering and Production Management by Martand T Telsang, S Chand publication, 2018
2. Industrial Engineering and production Management by M Mahajan, Dhanpat Rai and Co. Publishers, 2014.

REFERENCE BOOKS

1. Management: A Global & Entrepreneurial Perspective, Heinz Weihrich, Mark Cannice, and Harold Koontz, McGraw hill Education, 2010.
2. Work study by ILO, IV Revised Edition.
3. Industrial Engineering and Management by A Ravi Shankar, second edition, Galgotia publications,2001
4. Handbook of industrial Engineering: Technology and Operations Management, GayrielSalvendy, 3rd Edition, Wiley publication,2007
5. Maynard's Industrial Engineering Handbook, Kjell B. Zandin, Fifth Edition, 2001, The McGraw-Hill Companies, Inc.
6. Principles of Marketing - Basic concepts of Marketing Philip T. Kotler, Gary Armstrong, et al., Pearson, 2018.

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	2	2		1				1			3		2
CO2	3							1		2			3		
CO3	3	2		2		1				2	3		3		
CO4	3	3	2	2						2	2		3		3

MODELING LAB
20MEL401
IInd Year B. Tech.(Mech) Forth Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Prerequisites: None

Course Objectives:

1. To Paraphrase the capabilities of the software and commands
2. To enable the students create 3D models
3. To facilitate the students create 3D part drawing of machine components.
4. To generate the 3D assemblies of machine components

Course Outcomes: After the completion of the course the students will be able to

CO 1 Exemplify different user interface and tool bars of modelling software
CO 2 Implement the sketcher, features and dimensioning tool bar.
CO 3 Interpreting the steps for generation of the 3D parts of a product.
CO 4 Articulate the steps required for assemblies of various 3D machine components.

Course Content:
3D model generation using any of the modeling package

List of Exercises

1. Sketcher module
2. Part module
3. Special features in part module
4. 3D part modeling of machine components
5. 3D assemblies of machine components

TEXT BOOKS:

1. Toogood, R. (2021). *Creo Parametric 8.0 Advanced Tutorial*. SDC publications.

2. A Text book of “Machine Drawing” by K. L. Narayana, P. Kannaiah, K. Venkata Reddy.

REFERENCE BOOKS:

1. Lab manuals for 3D modelling

CO-PO Mapping															
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2			2				1					2	
CO2	2	1			1				1					2	
CO3	2	2			1				2					2	
CO4	2	2			3				3					1	

FUELS & OIL TESTING LAB
20MEL402
II Year B.Tech. (Mech) Fourth Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objective:
To make the students to determine various thermal properties of fuels experimentally.

Course Outcome:
Upon completion of the course the students will be able to

CO 1 Determine the Viscosity of the given oil using Viscometer.
CO 2 Calculate the percentage of carbon in a given oil.
CO 3 Measure Flash and Fire Points of the different fuels.
CO 4 Calorific value of various fuels like gaseous fuels.

Any **Ten** Experiments out of the following are to be performed

1. Viscosity measurement using Redwood No.I viscometer.
2. Viscosity measurement using Redwood No.II viscometer.
3. Viscosity measurement using Saybolt viscometer.
4. Viscosity measurement using Engler's viscometer.
5. Carbon residue test using Conradson's carbon residue apparatus
6. Calorific value of LPG using Junker's Gas Calorimeter
7. Measurement of flash point using Abel's apparatus
8. Measurement of flash point using Pensky-Martin's apparatus
9. Measurement of flash and fire points using Cleveland's open cup apparatus
10. Grease penetration test using Penetrometer apparatus
11. Calibration of pressure gauge using Dead weight pressure gauge.

Text Books:

1. Fuels and oils Testing Lab manual, Mechanical engineering department.
2. Practical Handbook on Fuel Properties and Testing by Sajid Zaman , Lambert Publications, 1st Edition, 2014.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2		1			2	3	2					2		

MACHINE SHOP PRACTICE
20MEL403
II Year B.Tech. (Mech) Fourth Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

The objective of this course is to make each student to aware the various manufacturing operations in order to meet the current industrial need. For the designed course the students will learn the following objectives.

1. To know the students how to make various types of external threads and other cutting operations like drilling and internal thread cutting by using Lathe

2. To know the procedure how to drill holes and make internal threads by using drilling machine and hand taps respectively.

3. To train each student various parts of milling machine and know the procedure how to perform different milling operations like key-way cutting, spur and helical gear cutting

4. To know how to make gear specimens using gear hobbing machine

5. To know how to produce flat surfaces/stepped surfaces and slant surfaces by using shaping machine

6. To know how to make operations on large work pieces by using planing machine and slotting machine

7. To know the various components of surface grinder/ tool and cutter grinder and to know how to perform grinding operations on work pieces/ single point cutting tools

Course Outcomes:

Upon completion of the course the students will be able to

CO 1 Perform various operations like drilling, boring, external and internal thread cutting operations on lathe machine, also perform drilling and tapping on drilling machine.
CO 2 Produce spur, helical gears on milling machine.
CO 3 Produce flat surface, stepped surface, dovetail surfaces on shaping machine.
CO 4 Operate gear hobbing, slotting, planning and grinding machines.

Syllabus:

TURNING :
L.H & R.H Threading, Multi-start threading, Drilling, Boring and Internal threading

DRILLING &TAPPING :
Drilling and Tapping of Different threads

MILLING :
Key-way, Spur and Helical Gear Milling, Gear Hobbing.

SHAPING :
At least three models involving production of flat surface, Stepped surface, Cutting dovetail and rectangular grooves.

PLANING AND SLOTTING :
Working on Planing and Slotting Machines

GRINDING :
At least one model on surface grinder, cylindrical grinder or tool and cutter grinder.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		2		1				1	1				1		
CO2		2		1				1	1				1		
CO3		2		1				1	1				1		
CO4		2		1				1	1				1		

SENSORICS & PLC LAB
20ME406/SO
II Year B.Tech.(Mech) Fourth Semester

Lectures	0	Tutorial	1	Practical	2	Credits	2
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

To make the students to understand and apply the concepts of sensors and PLC in automation.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO 1 Understand the principle & working of various sensors
CO 2 Application of sensors in various automated systems
CO 3 Understand the programming and function of PLC in automated manufacturing
CO 4 Understand the interfacing of sensors and PLC in automation

THEORY

Sensors & Transducers: basic principle of operation. Role of position / proximity sensors in automation. Sensitivity of proximity sensors. Criteria for Selection of sensors. PLC: Introduction. Basic architecture of PLC. Comparison of PLC with PC. Programming languages for PLC. Typical programs for logic based operations, sequential operations, Timer based and counting based applications.

LIST OF EXPERIMENTS

SENSORICS

1. Behaviour of inductive, capacitive and magnetic sensors.
2. Behaviour of through beam, reflex photoelectric and ultrasonic sensors.
3. Operating range, hysteresis and response curve of the inductive sensor.
4. Operating range, hysteresis and response curve of the capacitive sensor

PLC

1. Implementation of Logic gates using PLC
2. Implementation of Timers using PLC
3. Implementation of Counters using PLC.

4. Write a PLC program for Tank filling device simulator

5. Write a PLC program for Supervise equipment

6. Write a PLC program for Star-Delta starting up

REFERENCE BOOKS:

1. W.Bolton., "Mechatronics-Electronic control systems in Mechanical and Electrical Engineering", 3rd edition, Pearson Education Limited, New Delhi. [ISBN 81-7758-284-4]
2. W Bolton, "Industrial control and Instrumentation", 1993, Universities Press(India) private Limited, Hyderabad. [ISBN 81-7371-364-2]
3. W.Bolton,"Instrumentation & Process measurements", Orient LongmanLimited, Hyderabad. [OLBN 0 00212 008 9]
4. W.Bolton, "Programmable logic controllers" Fourth edition, Newnens-An Imprint of Elsevier 2009. [ISBN 978-81-312-1521-0]

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1			2								1	1	
CO2	3	2			2								1	2	
CO3	2	1			1								3	2	
CO4	2	1			2								3	2	

DYNAMICS OF MACHINES
20ME501
III Year B.Tech. (Mech) Fifth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:
To make the student to

1. equip with fundamental knowledge of dynamics of machines, so that student can identify and analyse the external and inertia forces associated with moving parts of a machine.
2. Develop understanding of vibrations and its significance in engineering design and analyse the same.

Course Outcomes:
After the completion of the course the students will be able to

CO1: Develop expressions for parameters of motion and find the dynamic forces in slider-crank mechanism & relate the working parameters of the governors.
CO2: Find the gyroscopic effect on naval ships, airplanes and two wheelers & balance rotating and reciprocating masses.
CO3: Find the parameters of free vibration of undamped and viscously damped systems with single DOF.
CO4: Find the parameters of forced vibration of a single DOF subjected to harmonic excitation.

UNIT-I

DYNAMIC FORCE ANALYSIS:
Introduction, D'Alembert's principle, Equivalent offset inertia force, Dynamic analysis of slider - crank mechanism (Using analytical method): Velocity and Acceleration of piston, Angular velocity and Angular acceleration of connecting rod, Piston effort (Effective driving force), Crank effort, Turning moment on crankshaft, Inertia of connecting rod. (6)

GOVERNORS:
Introduction, Types of governors, Watt governor, Porter governor, Hartnell governor, Sensitiveness of a governor, Hunting, Isochronism, Stability, Controlling force. (6)

UNIT-II

GYROSCOPES:
Angular velocity, Angular acceleration, Gyroscopic torque, Gyroscopic effect on naval ships, Stability of a two-wheel vehicle. (6)

BALANCING: Introduction, Static balancing, Dynamic balancing, Transferring of a force from one plane to another, Balancing of several rotating masses in different planes, Balancing of reciprocating mass (Single cylinder engine). (6)

UNIT-III

FUNDAMENTALS OF VIBRATION:
Introduction, Definitions, Vector method of representing harmonic motions, Addition of two simple harmonic motions of the same frequency. (4)

UNDAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS:
Introduction, Derivations of differential equations, Solution of differential equation, Torsional vibrations, Equivalent stiffness of spring combinations, Energy method. (4)

DAMPED FREE VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS: Introduction, Free vibrations with viscous damping, Logarithmic Decrement. (4)

UNIT-IV

FORCED VIBRATIONS OF SINGLE DEGREE OF FREEDOM SYSTEMS:
Introduction, Forced vibrations with constant harmonic excitation, Forced vibration with rotating and reciprocating unbalance, Forced vibrations due to excitation of the support, Vibration isolation and transmissibility, Vibration measuring instruments. (12)

TEXT BOOKS

1. Theory of Machines by S.S. Rattan, Tata McGraw Hill Education India Pvt. Ltd., New Delhi, 5th Edition,2019.
2. Mechanical Vibrations by G. K. Groover, Nem Chand & Bros., Roorkee, 8th Edition, 2009.

REFERENCE BOOKS

1. Theory of Machines by T. Bevan, Pearson, 3rd Edition, 2009.
2. Mechanical Vibration by S. S. Rao, Pearson, 6th Edition, 2018.

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2										1	3	2	
CO2	3	2										1	2	3	
CO3	3	2										1	3	3	
CO4	3	2										1	3	3	

DESIGN OF MACHINE ELEMENTS
20ME502
III Year B.Tech. (Mech) Fifth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

To make the student to

1. gain appreciation and understanding of the design function in mechanical engineering, the steps involved in designing and the relation of design activity with manufacturing activity
2. Select proper materials to different machine elements based on their physical and mechanical properties.
3. Learn and understanding of the different types of failure modes and criteria.
4. Design Procedure for the different machine elements such as fasteners, Power Screws, Springs etc.

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Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Apply the design procedure to engineering problems, including the consideration of technical and manufacturing constraints.
CO2: Select suitable materials in critical design applications.
CO3: Identify the loads, the machine members subjected and calculate static and dynamic stresses to ensure safe design.
CO4: Design various machine elements such as fasteners, Power screws and Springs etc.

UNIT-I

BASICS: Basic procedure of machine design, requirements and design of machine elements, traditional design methods. Design synthesis, use of standards in design, preferred numbers and significance. Common engineering materials and their properties. (6)

DESIGN FOR STATIC STRENGTH: Simple Stresses, Combined stresses, Torsional and bending stresses, stress strain relation, various theories of failure, Factor of safety and its importance in design. (6)

UNIT-II

DESIGN FOR FATIGUE STRENGTH: Stress concentration, stress concentration factors, reduction of stress concentration, fluctuating stresses, fatigue failure, endurance limit, low cycle and high cycle fatigue, notch sensitivity, reversed stresses, design for finite and infinite life, Soderberg and Goodman lines, , Gerber equation. (7)

THREADED JOINTS – Basic types, bolt of uniform strength, materials and manufacture, Eccentrically loaded bolted joints in shear. (5)

UNIT-III

RIVETED JOINTS: Types of riveted joints, Failures of riveted joints, Eccentrically loaded riveted joints, Design of boiler joints. (6)

WELDED JOINTS: Types of welded joints, Design of butt and fillet welded joints, Eccentrically loaded welded joints. (6)

UNIT-IV

POWER SCREWS: Types - Mechanics of power screws,self-locking of screw and stresses in screw, efficiency. (5)

SPRINGS: Introduction, Materials, Types of springs, Helical springs under axial load, Fatigue loading, leaf springs. (7)

TEXT BOOKS

1. V.B,Bhandari, " Design of Machine Element", Tata McGraw Hill book Co, Fourth Edition, 2017.
2. Joseph Shigley,Charles Mischke, Richard Budynas and Keith Nisbett " Mechanical Engineering Design", Tata McGraw-Hill book Co, Tenth edition,2020.

REFERENCE BOOKS

1. Robert L.Norton "Machine Design", Pearson, Fifth edition, 2017.
2. R.S.Khurmi and J.K.Guptha "Design of machine elements", S Chand, 25th Edition, 2020.
3. www.nptel.iitm.ac.in/video

HAND BOOKS TO BE ALLOWED IN SEMESTER EXAMINATION:

1. Design data book, P.S.G. College of Technology, Coimbatore
2. Design data book, Mahadevan & Balaveera Reddy –CBS Pub

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										1	3	2
CO2	3	2	1										1	3	2
CO3	3	2	1										1	3	2
CO4	3	2	1										1	3	2

MANUFACTURING TECHONOLOGY
20ME503
III Year B.Tech. (Mech) Fifth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment:			30	Semester End Examination (3 Hours):			70

Course Objectives:

1. To provide fundamental knowledge about measurement, standards, theory of limits and fits.
2. To describe the application of limit gauges, design of plug and ring gauges, use of sine bar, slip gauges.
3. To provide information about various comparators, projector and tool makers microscope.
4. To describe the importance of surface finish and its measurement, machine tool alignment tests.
5. To describe about the design principles and study of different types of jigs and fixtures.
6. To provide information about gear hobbing, gear shaping and gear finishing methods.
7. To describe about various sheet metal working operations like punching, blanking, drawing and bending operations.

Course Outcomes:

At the end of the course, the student will be able to:

CO 1 Describe the need for measurement, IS system of limits and fits, types of fits, interchangeability and design plain plug and ring gauges.

CO 2 Discuss about various comparators, projector and tool makers microscope, describe the terms associated with surface finish and its measurement using Talysurf and measure the effective diameter of screw thread by 3-wire method and conduct alignment tests on lathe and milling machines.

CO 3 Discuss about design principles of jigs and fixtures, gear hobbing and gear shaping and gear finishing operations. Describe briefly about additive manufacturing and its applications.

CO 4 Describe the sheet metal working operations like punching, blanking, drawing and bending and also design tooling for above operations and calculate the forces required.

UNIT-I

INTRODUCTION: Elements of engineering measurements, Standards of length, end and line standards. Theory of limits, Fits, Tolerances and their selection, Hole Basis and Shaft basis system, IS system of limits & fits, simple problems. Interchangeability, Selective Assembly. (6)

GAUGES: Limit gauges, Taylor's Principle of limit gauging, Plug gauges, Ring gauges and Design of plain cylindrical plug and ring gauges. Slip gauges, Angle gauges, Sine bar. (6)

UNIT-II

COMPARATORS:

Sigma comparator, Solex pneumatic gauge, projectors, Tool Maker's Microscope, Auto collimator, Bore gauge. (5)

MEASUREMENT OF SURFACE FINISH: Surface texture, roughness, waviness, Indian standard terminology, various methods of measuring surface finish, Tomlinson surface meter and Taylor Hobson Talysurf.

(3)

MEASUREMENT OF SCREW THREADS: Introduction-Types of threads-Measurement of outside diameter, root diameter, effective diameter using 3 wire method. (2)

MACHINE TOOL PERFORMANCE TESTS: Static and Dynamic alignment tests-Alignment tests on Lathe, Universal Milling Machine. (2)

UNIT-III

JIGS &FIXTURES : Introduction, design considerations for jigs & fixtures. The principle of six point location, locating pins. Clamping and clamping devices. A few examples of drilling jigs like box type, template jig, inverted jig, indexing jig. Fixtures – Lathe and milling. (6)

GEAR MANFUACTURING : Introduction to various gear manufacturing methods, gear shaping, gear hobbing - principles and methods, gear finishing methods. (3)

ADDITIVE MANUFACTURING: Introduction to additive manufacturing, Rapid prototyping verses additive manufacturing, Classification of AM processes, Stereo lithography process, Advantages, limitations and applications of AM.

(3)

UNIT-IV

PRESS WORKING TOOLS : Major components of a press, shear action in die cutting operation, centre of pressure and its calculation, scrap strip layout for blanking. (5)

Types of dies – compound die, combination die and progressive die. (3)

Drawing die – Calculation of blank size, number of draws, percentage reduction, radius on punch and die, drawing force.

(2)

Bending die – Bending methods, spring back, bending allowance, bending force. (2)

TEXT BOOKS

1. Engineering Metrology - R.K.Jain , Khanna publishers, 1st Esition, 2021.
2. A Text book of Production Engineering by P.C.Sharma, S.Chand& Co, Reprint 2019 Edition.

REFERENCE BOOKS

1. A text book of Engg.Metrology – I.C.Gupta, Dhanpatrai Publications,1st Edition 2019 Reprint.
2. Manufacturing engineering & technology by Kalpakjian, Pearson Education / PHI, 7th Edition, 2013.
3. Manufacturing Science by Amitabha Ghosh, Ashok Kumar Mallik, Prentice Hall.2nd Edition, 2010.

CO-PO MAPPING

Course outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1	1			1		1							
CO2	2	1	1			1		1							
CO3	2	1	1			1		1							
CO4	2	1	1	1	1	1		1							

ADVANCED STRENGTH OF MATERIALS
20ME504A-PEI
III Year B.Tech. Fifth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

To make the students to understand and analyze various types of beams, thick pressure vessels, rotating discs under various conditions including curved members, and to have the knowledge about strain energy of structural members under variety of loading conditions.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Determine the stresses caused due to temperature effects and analyze the indeterminate beams
CO2: Determine the shear stresses in beams and analyze the beams under unsymmetrical loading
CO3: Describe the analysis of curved members and thick cylinders
CO4: Understand the centrifugal stresses caused in rotating discs and the fundamental concept of strain energy

UNIT-I

TEMPERATURE STRESSES AND DYNAMIC LOADING: Thermal effects, misfits and pre strains. Dynamic loading, suddenly applied load, inelastic effects and causes of failure. (6)

STATICALLY INDETERMINATE BEAMS: Introduction, analysis by the differential equations of the deflection curve, moment area method (6)

UNIT-II

SHEAR STRESSES IN BEAMS: Shear stresses in Rectangular beams, Shear stresses the webs of beams with flanges, Shear stresses circular beams (6)

UNSYMMETRIC BENDING: Introduction, Doubly symmetric beams with skew loads, pure bending of unsymmetric beams, generalized theory of pure bending of beams under lateral loads (6)

UNIT-III

BENDING OF CURVED MEMBERS: Introduction, Winkler-bach formula to determine the stresses in the curved beams of various cross sections such as rectangular, triangular, circular and trapezoidal (6)

THICK PRESSURE VESSELS: Thick cylinders, lame's theory, radial deflection, compound cylinder. (6)

UNIT-IV

CENTRIFUGAL STRESSES: Introduction, rotating ring, rotating disc (solid and hollow), disc of uniform strength (7)

STRAIN ENERGY: Expressions for strain energy under various loads (axial, pure shear, bending and torsion) (5)

TEXT BOOKS

1. 'Mechanics of Materials' by James M Gere and Barry J Goodno, Enhansed 9th Edition, Cenegage Publishers, 2020.
2. 'Strength of Materials' by Dr. Sadhu Singh, 1st Edition, Khanna Publishers, 2016.

REFERENCE BOOKS

1. 'Mechanics of Materials' by Ferdinand J. Beer, Russell E. Johnston Jr, 8th Edition (in SI Units), Mc Graw Hill Publications, 2020.
2. "Strength of materials by S.S.Rattan, 3rd Edition, Mc Graw Hill Publications, 2016.
3. 'A text book of Strength of Materials' by R K Rajput, 7th Edition, S Chand Publications, 2018.
4. 'A text book of Strength of Materials' by R K Bansal, 6th Edition, Laxmi Publications, 2022.

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2										2	2	1
CO2	2	2	2										2	2	1
CO3	2	1	1										2	2	1
CO4	2	2	2										2	1	2

NON-DESTRUCTIVE EVALUATION
20ME504B-PEI
III Year B.Tech. (Mech) Fifth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

To make the students to understand and apply the fundamental concepts of Non-destructive evaluation of engineering materials.
To enable selection of suitable NDT methods
To identify advantages and limitations of various Non-Destructive Testing methods
To make aware the developments and future trends in Non-Destructive Testing methods

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Understand the fundamental concepts of Non-destructive Testing Methods
CO2: Illustrate the Magneto particle Inspection on various materials
CO3: Describe the Concepts of Ultrasonic Testing and use of industrial needs
CO4: Define the basic concepts of Radiography testing and Eddy current testing

UNIT-I

INTRODUCTION TO NON DESTRUCTIVE TESTING AND SURFACE TESTING METHODS: Introduction, NDT versus Destructive Testings, over view of non-destructive testing methods for detection of manufacturing defects. Relative merits and limitations, economics aspects of NDT. (2)

VISUAL INSPECTION -tools, applications and limitations – Fundamentals of visual testing: vision, lighting, material attributes, environmental factors. Visual perception, direct and indirect methods mirrors, magnifiers, boroscopes, fibroscopes, closed circuit television, light sources. Special lighting, a systems, computer enhanced system. (5)

LIQUID PENETRANT INSPECTION Principles, properties required for a good penetrants and developers - Types of penetrants and developers and advantages and limitations of various methods of LPI - LPI technique/ test procedure. Interpretation and evaluation of penetrant test indications, false indication and safety precaution required in LPI, applications, advantages and limitations. (5)

UNIT-II

MAGNETIC PARTICLE INSPECTION (MPI): Principles of MPI, basic physics of magnetism, permeability, flux density, cohesive force, magnetizing force, retentively, residual magnetism. Methods of magnetization, magnetization techniques such as head shot technique, cold shot technique, central conductor testing, magnetization using products

using yokes. Direct and indirect method of magnetization, continuous testing of MPI, residual technique of MPI, system sensitivity, checking devices in MPI. Interpretation of MPI, indications, advantage and limitation of MPI. (12)

UNIT-III

ULTRASONIC TESTING (UT): principle, types of waves, frequency, velocity, wavelength, reflection, divergence, attenuation, mode conversion in ultrasonic UT testing methods. Contact testing and immersion testing, normal beam and straight beam testing, angle beam testing, dual crystal probe, ultrasonic testing techniques, instruments used UT, accessories such as transducers, types, frequencies, and sizes commonly used. Applications, advantages, limitations, A, B and C scan - Time of Flight Diffraction (TOFD).
(12)

UNIT-IV

RADIOGRAPHY TESTING (RT): Principle, electromagnetic radiation sources: X-ray source, production of X-rays, high energy X-ray source, gamma ray source - Properties of X-rays and gamma rays. Inspection techniques like SWSI, DWSI. Safety aspects required in radiography applications, advantages and limitations of RT.
(6)

EDDY CURRENT TESTING (ECT): Principle, physics aspects of ECT like conductivity, permeability, resistivity, inductance, inductive reactance, impedance.
Equipments and accessories, various application of ECT such as conductivity measurement, hardness measurement, defect detection, coating thickness measurement, advantages and limitations of eddy current testing. (6)

TEXT BOOKS

1. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition (2002).
2. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition (2011).
3. Non-Destructive Examination and Quality Control, ASM International, Vol.17, 9th edition (1989)

REFERENCE BOOKS

1. C. Hellier, Handbook of Non Destructive Evaluation, McGraw-Hill Professional, 1st edition (2001).
2. N. A. Tracy, P. O. Moore, Non-Destructive Testing Handbook: Liquid Penetrant Testing, Vol. 2, American Society for Non-destructive Testing, 3rd edition (1999).
3. J. Thomas Schmidt, K. Skeie and P. MacIntire, ASNT Non Destructive Testing Handbook: Magnetic Particle Testing, American Society for Non-destructive Testing, American Society for Metals, 2nd edition (1989).

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1										1	2	2
CO2	2	2	1	1			1						1	2	2
CO3	2	1	1				1						1	2	2
CO4	2	2	1				1						1	2	2

I.C. ENGINES & GAS TURBINES
20ME504C-PEI
III Year B.Tech. (Mech) Fifth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:
To make the students
1. To discuss fuels and fuel supply systems.
2. To explain the combustion phenomenon and analyse the performance of IC engines.
3. To study and analyse reciprocating and rotary compressors.
4. To demonstrate gas turbines and jet propulsion systems.

Course Outcomes:
After completion of the course the student will be able to:

CO 1 To perceive the knowledge of IC engine fuels and fuel supply systems.
CO 2 To understand the combustion phenomenon and analyse the performance of IC engines.
CO 3 To explain and interpret the performance of reciprocating and rotary compressors.
CO 4 To illustrate the working principles of gas turbines and jet propulsion.

UNIT-I
I.C. ENGINES: Introduction, valve timing and port Timing diagrams, Alternative fuels: Liquid fuels - Alcohol, Methanol, Ethanol, Gaseous fuels –Hydrogen, Natural Gas and Liquefied Petroleum and Bio Fuels. (6)

FUEL SUPPLY SYSTEMS: S.I. Engines- Chemically correct air-fuel ratio, Air-fuel mixture requirements, Carburetion, Simple float type carburetor, injection system, types, electronic fuel injection system, MPFI. **C. I. Engines-** Air- fuel requirements, fuel supply and injection systems, Bosch fuel pump, electronic injection system, CRDI. (6)

UNIT-II
COMBUSTION PROCESSES: S.I. Engines- Normal combustion, abnormal combustion, Knock rating and Octane number. **C.I. Engines-** Ignition delay, combustion knock in C.I. engines, Knock rating and Cetane number. Combustion chambers for S.I and C.I engines- Turbo charging and Supercharging. (6)

PERFORMANCE OF I.C. ENGINES: Indicator diagram, evaluation of Indicated Power, Brake power, Fuel consumption, SFC, Mechanical & thermal efficiencies, mean effective pressure, air-fuel ratio, Heat balance, Engine performance curves, Variables affecting engine performance for both S.I. & C.I. Engines. (6)

UNIT-III

RECIPROCATING AIR COMPRESSORS: Classification, Reciprocating Air compressor with out and with clearance volume, volumetric efficiency, multi-stage compression, Effect of inter cooling, optimum intermediate pressure in a two-stage compressor. (6)

ROTARY COMPRESSORS: Classification, working principles of Centrifugal compressor and Axial flow compressor, Surging, Choking and Stalling. Comparison of Centrifugal and Axial compressor. Comparison of Reciprocating and Rotary compressors, (6)

UNIT-IV

GAS TURBINES: Closed and Open cycle gas turbines, analysis of closed cycle gas turbine, efficiencies of Compressor and turbine, cycles with intercooling, reheat and regeneration. (7)

JET & ROCKET PROPULSION: Basic principles of Jet propulsion - specific thrust, propulsive efficiency and overall thermal efficiency of a jet engine, Principles of Rocket propulsion, Types of rocket propulsion. (5)

TEXT BOOKS

1. Thermal Engineering- Rajput,10th Edition,Laxmi Pub, New Delhi, 2020.
2. Internal Combustion Engines - V.Ganeshan,4th Edition, Tata McGraw – Hill Publishing Company Ltd,2017.

REFERENCE BOOKS

1. Fundamentals of I.C. Engines - P.W. Gill, J.H. Smith & Ziurys,4th Edition, IBH & Oxford publications, Mumbai,2007.
2. A Course in I.C. Engines - M.L. Mathur& R.P. Sharma - DhanpatRai& Sons- New Delhi.
3. Gas Turbine Theory - Cohen, Rogers and Sarvanamuttu.7th Edition,Pearson publishers,2017.
4. Treatise on heat Engineering - Vasandani& Kumar, 4th Edition,Metropolitan Book Company, New Delhi,2008.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2		1			2	3	1					1	2	
CO2	2	1	1	1			1						2	1	
CO3	2	1				1							1	1	
CO4	2	2				1	1						1	2	

Nanotechnology
20ME504D-PEI
Third Year B.Tech. (Mech) fifth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment:			30	Semester End Examination (3 Hours):			70

Course Objectives:

1. To familiarize with the fundamentals of nanotechnology, evolution of the nano-science and potential applications.
2. To explore the available nanomaterials based on carbon, metals and metal oxides developed for industrial applications.
3. To familiarize the existing synthesizing processes to develop various nano-surfaces and nanomaterials.
4. To acquire sound knowledge on different characterization methods developed for studying nanomaterials.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO 1 Understand the importance of nanotechnology for emerging engineering applications.

CO 2 Differentiate the nano materials based on the composition and physical properties.

CO 3 Select appropriate process to produce nano materials in the form of powders or bulk structures.

CO 4 Investigate the fundamental properties of nano materials by using appropriate characterization technique.

UNIT-I :

Introduction: History of nano science, definition of nanometer, nanomaterials, nanotechnology. Why nanomaterials? Properties of materials influenced by nanosize: mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto-electronic properties. Levels of structures, effect of size reduction on properties. (12)

UNIT-II:

Different classes of nanomaterials: classification based on dimensionality-quantum dots, wells and wires, Carbon-based nanomaterials - bucky balls, carbon nanotubes, graphene, Metal based nanomaterials - nanogold, nanosilver and metal oxides, nanocomposites, nanopolymers, nanoglasses, nanoceramics, biological nanomaterials. (12)

UNIT-III:

Synthesis and fabrication: Synthesis of bulk polycrystalline nanomaterials, growth of single crystals. Synthesis techniques for preparation of nanoparticle – bottom up approach – sol

gel synthesis, hydrothermal growth, thin film growth, PVD and CVD; top down approach – ball milling, micro fabrication, lithography, mechanical processing-severe plastic deformation techniques. (12)

UNIT-IV:

Charecterization of nanomaterials: X-Ray diffraction method, scanning electron microscopy (SEM), transmission electron microscopy (TEM), atomic force microscopy, particle size analysis. Applications of nanotechnology in medicine, surface science, energy and environment sciences. Challenges and limitations in processing, handling, toxicity and issues with safety measures. (12)

TEXT BOOKS

1) M.S Ramachandra Rao, Tatsuo Okada, Nano science and nano technology, Wiley publishers, 2013
2) B.S. Murty, P. Shankar, B. Raj, B.B. Rath, J. Murday, Textbook of Nanoscience and Nanotechnology Springer publishers, 2013

REFERENCE BOOKS

1) Charles P. Poole, Jr., Frank J.Owens, Introduction to Nano Technology Wiley publishers. USA, 2007
2) Jermy J Ramsden, Nanotechnology, Elsevier publishers, USA, 2016
3) M.A Shah, K.A Shah, Nanotechnology the Science of Small Wiley Publishers, 2015

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2		1	1	1	1	1	1	1		1	2	1	2
CO2	2	1	1	2	3	2	2	1	2	2		2	2	2	1
CO3	3	2	2			3	1	2	1	3		1	2	1	3
CO4	2	1	2	2	2	1		1	2	2	1	2	2	1	2

IC ENGINES LAB
20MEL501
III Year B.Tech. (Mech) Fifth Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To enable the students to understand the principles, working and performance of I.C engines
2. To introduce the students the working of reciprocating air compressor and blower.

Course outcomes:

After completion of this course, students will be able to

CO 1 Understand the complete operation of 2-stroke and 4-stroke I.C engines through Valve timing and Port timing diagrams, load test and heat balance test.

CO 2 Analyze the performance of blower and compressor.

List of experiments

1. Valve timing diagrams on 4-stroke single cylinder petrol and diesel engine models.
2. Port Timing diagram on 2 stroke single cylinder petrol engine model.
3. Air compressor- to determine volumetric and isothermal efficiencies
4. Blower test rig- to determine overall efficiency
5. Two stroke single cylinder petrol engine – load test
6. Four stroke single cylinder petrol engine - load test & motoring test
7. Four stroke four cylinder petrol engine – load test
8. Four stroke four cylinder petrol engine – heat balance test
9. Four stroke four cylinder petrol engine – Morse test
10. Four stroke four cylinder diesel engine – load test
11. Four stroke four cylinder diesel engine – heat balance test
12. Four stroke single cylinder petrol engine – variable compression ratio test
13. Computer interfaced single cylinder Four stroke petrol engine – load test
14. Computer interfaced single cylinder Four stroke diesel engine – load test

Any 10 Experiments.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2		1						1		1	2	2	
CO2	3	2		1						1		1	2	2	

DESIGN & METROLOGY LAB
20MEL502
III Year B.Tech. (Mech) Fifth Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives: At the end of the course the students will be able to:

1. Measure the taper angle using sine bar in conjunction with slip gauges, dial indicator, and surface plate.
2. Measure the angle between surfaces using bevel protractor.
3. Use micrometer to determine diameter & thickness of given work piece and to use control charts to make decisions about the lot.
4. Measure the chordal width and chordal height of given gear wheel using gear tooth vernier.
5. Use bore dial gauge to measure the internal diameter of work piece & to check taper and ovality of the bore.
6. Measure pitch angle, depth of a given thread pitch gauge.
7. Measure the taper of given work piece using taper plug gauge.
8. Measure pitch, depth, angle of given pitch gauge by using profile projector.
9. Measure diameter and thickness using dial caliper.
10. Measure pitch, depth and included angle of thread.

Course Outcomes: After the completion of the course the students will be able

CO 1 To illustrate the concepts of accuracy and precision through experiments.

CO 2 To Analyze limits and tolerances for engineering components.

CO 3 To illustrate the use of various measuring tools measuring techniques.

CO 4 To make student understand importance of statistical quality control techniques using experiments.

Syllabus:

List of experiments:

1. Angle measurement by Bevel Protractor.
2. Angle and taper measurement by sine bar.
3. Measuring effective dia. of thread using 3 - wire method.

4. Measuring gear tooth thickness using gear tooth vernier.
5. Measuring internal diameter using bore dial gauge.
6. Measuring external diameters using Micrometer& Plotting $\bar{X}$ & R Charts
7. Measuring different parameters of a thread / gear tooth using profile projector
8. Measuring different parameters of a thread / gear tooth using Tool Makers Microscope.
9. Measurement of external diameter and thickness using Dial caliper.
10. Measurement of taper angle using taper plug gauge.
11. Balancing machine
12. Wear & Friction measurement
13. Journal Bearing apparatus
14. Fatigue test
15. Photo elasticity bench setup

TEXT BOOKS:

1. Metrology - R.K.Jain , Khanna publishers, 21st edition, 1984.
2. Mechanical Measurements & Control - by D.S. Kumar, 5th edition, 2019.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2													2	
CO2	3		2		2									2	
CO3	2													2	
CO4	2													3	

INTERNET OF THINGS
20ME506/ SO
III/IV B. Tech Fifth Semester

Lectures		Tutorial	1	Practical	2	Credits	2
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

To introduce the smart connected systems design using Internet of Things, Cloud storage and industrial automation.

Course Outcomes:

After successful completion of course, a student should be able to

CO 1 Understand internet of Things and its hardware and software components
CO 2 Acquire Knowledge on Interface I/O devices, sensors & communication modules
CO 3 Able to design remotely monitor data and control devices
CO 4 Able to develop real life IOT based projects.

List of Experiments

1. a) Familiarization with Arduino/Raspberry Pi and perform necessary software installation.
   b) Study the fundamental IOT Software & Components.

Arduino :

2. a) To interface LED/Buzzer with Arduino and write a program to turn ON LED for 1 sec after every 2 seconds.
   b) To interface Push button/Digital sensor (IR/LDR) with Arduino and write a program to turn ON LED when push button is pressed or at sensor detection.
   c) To interface DHT11 sensor with Arduino and write a program to print temperature and humidity readings.
3. To interface motor using relay with Arduino and write a program to turn ON motor when push button is pressed.
4. To interface OLED with Arduino and write a program to print temperature and humidity readings on it
5. To interface Bluetooth with Arduino and write a program to send sensor data to smart phone using Bluetooth.
6. To interface Bluetooth with Arduino and write a program to turn LED ON/OFF when '1'/'0' is received from smart phone using Bluetooth.

Raspberry pi :

7. To interface motor using relay with Raspberry Pi and write a program to turn ON motor when push button is pressed.
8. Write a program on Raspberry Pi for weather monitoring station and handling temperature & humidity values on cloud platform.

Application :

9. Design of smart water tank and reading continuous water level using Arduino.
10. a) Design of heart beat monitoring system by interfacing pulse sensor to Arduino.
    b) Design of soil moisture monitoring system using Arduino.

THEORY:

Introduction to Internet of Things, Characteristics of IoT, Physical design of IoT, Functional blocks of IoT, Sensing, Actuation, Basics of Networking, Communication Protocols, Sensor Networks, Design Principles for Connected Devices;Internet Principles. Embedded Computing Basics, Arduino, Raspberry Pi, Prototyping online Components – Getting Started with an API, Writing a New API, Automatic Storage Management in a Cloud World – Introduction to Cloud, Relational Databases in the Cloud, Industry 4.0., Application of IoT for Mechanical Engineering- Case study.

TEXT BOOKS:

1. A. McEwen and H. Cassimally, Designing the Internet of Things, 1st edition, Wiley, 2013, ISBN-10: 111843062X.
2. N. Vengurlekar and P. Bagal, Database Cloud Storage: The Essential Guide to Oracle Automatic Storage Management, 1st edition, McGraw-Hill Education, 2013, ISBN-10: 0071790152.

REFERENCES:

1. M. Kuniavsky, Smart Things: Ubiquitous Computing User Experience Design, 1st edition, Morgan Kaufmann, 2010, ISBN-10: 0123748992.
2. F. Lamb, Industrial Automation: Hands on, 1st edition, McGraw-Hill Education, 2013, ISBN-10:0071816453.

CO- PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	1												2	2
CO2	2	1													
CO3	1	2													
CO4	1	2				3				2				2	2

Design Thinking & Product Innovation
20ME507/ MC
III Year B.Tech. (Mech) Fifth Semester

Lectures	2	Tutorial	0	Practical	0	Credits	0
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			0

Course Objectives:

1.To familiarize product design process
2.To introduce the basics of design thinking
3.To bring awareness on idea generation
4.To familiarize the role of design thinking in services design

Course Outcomes:

After completing this unit, the student will be able to

CO 1 Identify characteristics of successful product development and opportunities for new product development.
CO 2 Explain the principles of Design Thinking and identify the benefits of Design Thinking.
CO 3 Explain the techniques in idea generation and select ideas from ideation methods.
CO 4 Use Design Thinking in business process model and apply Design Thinking for Agile Software development.

Unit 1

Introduction to design, characteristics of successful product development, product development process,identification of opportunities, product planning, Innovation in product development.
(8)

Unit 2

Design Thinking: Introduction, Principles, the process, Innovation in Design Thinking, benefits ofDesign thinking, design thinking and innovation, case studies. (8)

Unit 3

Idea generation: Introduction, techniques, Conventional methods, Intuitive methods, Brainstorming,Gallery method, Delphi method, Synectics etc
Select ideas from ideation methods, case studies. (8)

Unit 4

Design Thinking in Information Technology, Design Thinking in Business process model, DesignThinking for agile software development, virtual collaboration, multi user and multi account interaction.Need for communication, TILES toolkit, Cloud implementation. (8)

Text Books:

1. Pahl, Beitz, Feldhusen, Grote – Engineering Design: a systematic approach, Springer, 2007
2. Christoph Meinel and Larry Leifer, Design Thinking, Springer, 2011

Reference Books:

1. AdersRiiseMaehlum - Extending the TILES Toolkit – from Ideation to Prototyping
2. http://www.algarytm.com/it-executives-guide-to-design-thinking:e-book.
3. Marc stickdorn and Jacob Schneider, This is Service Design Thinking, Wiely, 2011

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	1	1		2	3	1					3		
CO2	2	2	1			3	1				1		2	3	
CO3	1	3			2	1			1	2		2222	2	2	
CO4	2	1	3	1					2		3	2	2	2	

Summer Internship
20MEL503
III Year B.Tech. (Mech) Fifth Semester

Lectures	0	Tutorial	0	Practical	0	Credits	1.5
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Summer Internship at the end of IV semester carried out in industry is to be evaluated in V semester based report and certificate provided by the industry. The report and certificate will be evaluated by the department committee for 100 marks. 50 marks shall be for the report and certificate and 50 marks based on seminars/presentation to the department committee by the student.

CAD/CAM
20ME601
III Year B.Tech. (Mech) Sixth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives
This Course is used to give fundamentals of modern Design and Manufacturing with the help of Computer.

Course Outcomes
On successful implementation of the course the student will be able to
CO 1 Understand the fundamentals of computer, CAD along with algorithms for drawing.
CO 2 Apply different Geometric Modelling Techniques.
CO 3 Comprehend fundamentals of NC technology and Part Programing.
CO 4 Know the importance of group technology, and other elements CIM.

UNIT I
INTRODUCTION
Introduction to CAD/CAM, Product Life Cycle , Role of CAD/CAM in Product Life Cycle.

Origin of computer graphics , Input, Output Devices , Display devices -Basic CRT, DVST , Modern Display devices - LCD, LED

Algorithms for line and circle – Bresenham's algorithm and simple problems

2D and 3D transformations – translation, rotation, scaling– concatenation.
(12)

UNIT II
SURFACE AND SOLID MODELING
Parametric and Non Parameteric Representation of analytical Curves, Curve representation – Bezier, cubic spline, B-spline (Theory Only)

Wireframe, Surface and Solid Modelling (CSG, B- Rep) (12)

UNIT – III
NUMERICAL CONTROL
Introduction, basic components of an NC system, classifications of NC systems, nomenclature of NC machine axes, interpolation methods, features of CNC, the machine control unit for CNC, direct numerical control, distributed numerical control, applications of NC, advantages and disadvantages of NC.

NC PART PROGRAMMING: NC coding systems, manual part programming, simple examples on milling and turning operations, computer assisted part programming, part programming with APT language, simple examples in milling operations. (12)

UNIT – IV

GROUP TECHNOLOGY & CELLULAR MANUFACTURING: Introduction, part families, parts classification and coding, features of parts classification of coding system, selecting a coding system, developing coding system in an industry OPITZ, MICLASS

COMPUTER AIDED PROCESS PLANNING: Introduction, retrieval CAPP system, generative CAPP systems, benefits of CAPP.

FLEXIBLE MANUFACTURING SYSTEMS: Introduction, types of FMS, components, FMS layout configurations, computer control system, human resources, applications and benefits.

Introduction to Computer Integrated Manufacturing. (12)

TEXT BOOK:

1. CAD/CAM by M.P.Groover and E.W.Zimmers, 1st edition,Pearson Education / PHI,1984.
2. Ibrahim Zeid " CAD/Cam Theory and Practice", Indian Edition, Mc.Graw Hill, 2009.

REFERENCE BOOKS:

1. Automation, Production systems and Computer Integrated Manufacturing by M.P.Groover, 4th Edition,Pearson Education / PHI, 2015.
2. CAD/CAM by P.N.Rao, 3rd Edition,TMH publishers,2017.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	2	3					3		2	2	2	2
CO2	2	2	3	2	3					3		2	2	2	2
CO3	2	2	3	2	3					3		2	2	2	2
CO4	2	2	3	2	3					3		2	2	2	2

DESIGN OF TRANSMISSION ELEMENTS
20ME602
III Year B.Tech. (Mech) Sixth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. Selection of proper materials to different machine elements based on their physical and mechanical properties.
2. To understand the principles involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
3. This course gives the insight of slider and roller bearings and the life prediction.
4. Design the power transmission elements such as Shafts, Keys, Couplings, belts, gears, brakes and clutches.

Course outcomes:

Upon successful completion of this course student should be able to:

CO 1 Utilize design data hand book and design the elements for strength, stiffness and fatigue.

CO 2 Identify the loads, the machine members subjected and calculate static and dynamic stresses to ensure safe design.

CO 3 The student will able to select the suitable bearing based on the application of the loads and predict the life of the bearing.

CO 4 Design power transmission elements such as Shafts, Keys, Couplings, belts, gears, brakes and clutches.

UNIT I

SHAFTS: Design of solid and hollow shafts for strength, Rigidity – For Bending, Torsion, Combined bending and torsion and combined bending, torsion and axial loads (6)

KEYS: Introduction, Design of square and flat keys (2)

SHAFT COUPLINGS: Rigid couplings: Muff Coupling, Flange coupling, Bushed pin flexible coupling. (4)

UNIT II

BALL AND ROLLER BEARINGS: Static load, Dynamic load, Equivalent radial load, selection of ball and roller bearings. (6)

BEARINGS AND LUBRICATION: Lubrication, Types of lubrications, types of lubricants, properties of lubricants, types of Bearings, Bearing materials, Journal bearing design (using McKee's equation and Raymond and Boyd charts tables) (6)

UNIT III

BELT DRIVES: Flat and V-belts, Belt constructions, Geometrical relationships, Analysis of belt tensions, condition for maximum power, Selection of Flat-belts, Selection of V- belts (5)

BRAKES AND CLUTCHES: - Introduction to Brakes, Types, Analysis and design of block brakes, band brakes, Internal shoe brakes, external shoe brakes, pivoted shoe brakes, Temperature rise, Friction materials, Clutches, Analysis and design of simple and multiple disc clutches, friction materials, comparison of brakes and clutches. (7)

UNIT IV

FLYWHEEL: Introduction, construction, Torque analysis, solid flywheel, Rimmed flywheel, stresses in rimmed flywheel, Design of flywheel. (6)

SPUR GEARS: Classification of gears, Terminology of spur gear, standardsystems of Gear Tooth, Force analysis, Gear tooth failures, Selection of material, Beam Strength of gear teeth, lubrication, Lewis Equation. (6)

TEXT BOOKS:

1. Bhandari, -Design of machine elements‖, Tata McGraw Hill book Co, Fourth edition, 2017.
2. Joseph Shigley,Charles Mischke, Richard Budynas and Keith Nisbett —Mechanical Engineering Design‖, Tata McGraw-Hill book Co, Tenth edition,2020.

REFRENCE BOOKS:

4. R.S.Khurmi and J.K.Guptha “Design of machine elements”, S Chand, 25th Edition, 2020.
5. Robert L.Norton —Machine Design‖, Pearson, Fifth edition, 2017.

HAND BOOKS TO BE ALLOWED IN SEMESTER EXAMINATION:

1. Design data book, P.S.G. College of Tech, Coimbatore
2. Design data book, Mahadevan & Balaveera Reddy –CBSPub.

COURSE RELEVANT WEBSITE:

1. WWW.nptel.iitm.ac.in/video

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	3	1										1	3	2
CO2	3	2	1										1	3	2
CO3	2	3	1										1	3	2
CO4	3	2	1										1	3	2

HEAT TRANSFER
20ME603
III Year B.Tech. (Mech) Sixth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course objectives

To make the students to

1. Describe one dimensional heat conduction and solve numerical problems.
2. Demonstrate forced convection heat transfer along with boundary layer theory and solve numerical problems.
3. Analyse the concepts of free convection, heat exchangers, LMTD and NTU methods of heat exchanger analysis.
4. explain radiation heat transfer and evaluate shape factors, radiation heat exchange between two bodies.

Course outcomes

Student will be able to

CO 1 Interpret the basic concepts of conduction, convection and radiation heat transfer and formulate & solve one dimensional conduction heat transfer problems.

CO 2 Describe the relationship between fluid flows and convection heat transfer, apply empirical correlations to estimate forced convection heat transfer.

CO 3 Apply empirical correlations for free convection to estimate heat transfer and design double pipe heat exchanger using either LMTD method or NTU method

CO 4 Describe the basic concepts of radiation heat transfer and able to estimate radiation heat transfer between bodies with the aid of shape factors.

UNIT-I

INTRODUCTION: Basic Modes and Laws of Heat transfer, thermal conductivity, Steady state Heat Conduction, General conduction equation in Cartesian and Cylindrical coordinates, initial and boundary conditions. (3)

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, Thermal contact resistance, problems on variable thermal conductivity, critical insulation thickness, uniform heat generation in slabs. (6)

EXTENDED SURFACES: Types, Applications, Fin materials, Heat transfer from fins with uniform cross section, Fin efficiency and Effectiveness. (3)

UNIT-II

TRANSIENT HEAT CONDUCTION (One dimensional only) - Lumped heat capacity systems. (2)

FORCED CONVECTION: Introduction to boundary layer and dimensional analysis for natural and forced convection, Correlations for heat transfer in Laminar and Turbulent flows over a flat plate and in pipes (10)

UNIT-III

NATURAL CONVECTION: Correlations for vertical and horizontal plates, vertical and horizontal cylinders. (3)

BOILING AND CONDENSATION: Boiling, Pool boiling regimes, Condensation, Laminar film wise condensation, condensation on vertical plate, horizontal tubes, dropwise condensation. (3)

HEAT EXCHANGERS: Types of heat exchangers, Fouling, LMTD and NTU methods of Heat exchanger, Analysis for double pipe heat exchanger. (6)

UNIT-IV

RADIATION: Fundamentals of Radiation: Basic Concepts and definitions, Absorptivity, Reflectivity, Transmissivity, concept of Black body, Laws of Radiation, Kirchhoff's law, Planck's law, Wein's law, Stefan Boltzman's law. (6)

RADIANT HEAT TRANSFER: Heat Exchange by radiation between two finite parallel surfaces, Electrical analogy, radiant heat transfer between two finite black and gray surfaces, shape factor, Radiation shields. (6)

TEXT BOOKS

1. Heat and Mass Transfer – Sachdeva, 5th Edition,New Age India, New Delhi,2017.
2. Heat Transfer by Er.R.K.Rajput, S .Chand publications, 7th Edition,New Delhi.2019.

REFERENCE BOOKS

1. Heat transfer - J.P.Holman, 10th Edition,MGH, New York, 2017.
2. Heat transfer - S.P.Sukhatme,4th Edition Universities press publishers,2005.
3. Heat Transfer – Yunus A. Cengel, Afshin J. Ghajar,5th Edition, TMH, New Delhi, 2015.

NOTE: Heat and Mass Transfer Data Book by Kothandaraman and Subramanian to be allowed in University Examination.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1				2			1			2		1	2	1
CO2	1				2						2		2	2	2
CO3	1				2			2					2	2	1
CO4	1				2			2					2	2	2

FINITE ELEMENT ANALYSIS
20ME604A-PEII
III Year B.Tech. (Mech) sixth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:
To provide concepts on Finite Element Analysis and to help the students to use this method and to solve the problems in structural analysis and in heat transfer

Course Outcomes:
CO1: Students able to derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts
CO2: Apply direct stiffness, Galerkin method to solve engineering problems and outline the requirements for convergence
CO3: Analyse the linear 1D problems like bars and trusses; 2D structural problems using CST elements
CO4: Solve the 1-Dimentional dimensional heat conduction problems using triangular elements

UNIT-I

Fundamental concepts: Introduction, historical background, Analysis of 3-D stresses & strains, stress-strain relations, stress cubic, principal stress calculations, temperature effects, potential energy and equilibrium. (12)

UNIT-II

Basic concepts of FEA and One-Dimensional problems: Fundamental concepts, Finite Element Modelling, Coordinates and Shape functions, The Potential Energy Approach, The Galerkin Approach, Assembly of the Global Stiffness Matrix and Load Vector, Properties of Global Stiffness Matrix, The Finite Element equations; Treatment of boundary conditions, Examples of Axially Loaded Members (8)

Truss analysis: initial conditions for the truss system, transformation matrix, analysis of truss using FEM for three truss members. (4)

UNIT-III

Two Dimensional Problems: Introduction, Plane Stress and Plane Strain, Finite Element Modelling, Constant Strain Triangle (CST); Iso-parametric representation, Potential Energy Approach, Element Stiffness, Force terms, Galerkin Approach, Stress calculation, Problem modelling and boundary conditions, Examples of plane Stress and plane Strain problems with three degrees of freedom using CST Element. (12)

UNIT-IV

Scalar Field Problems: Introduction, study-state heat transfer, one-dimensional heat conduction, governing equation, boundary conditions, the one-dimensional element, functional approach for heat conduction. (12)

TEXT BOOKS

1. Introduction to Finite Elements in Engineering by Chandrupatla & Belegundu, 3rd edition, PHI.
2. Experimental Stress analysis by P. Seshu, PHI, 2012.

REFERENCE BOOKS

1. Finite Element Analysis by C.S.KrishnaMoorthy, McGraw Hill Publications, 2017.
2. Finite Element Analysis by L.J.Segerlind, Wiley Publications, 2nd edition, 1984.
3. Cook, Robert Davis et al, "Concepts and Applications of Finite Element Analysis" , Wiley, John & Sons,1999
4. George R Buchanan, "Schaum's Outline of Finite Element Analysis", McGraw Hill Company, 1994.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1		1								2	1	2
CO2	3		2		2								2	2	2
CO3	3	2	2		2								2	2	2
CO4	3	2	2		1								2	1	2

NON-CONVENTIONAL ENERGY SOURCES
20ME505B-OEI
III Year B.Tech. (Mech) Fifth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To enable students to identify different sources of non conventional energy and innovative Technologiesin harnessing energy from these sources.
2. Understand the energy conversion from wind energy, geothermal energy, Biomass, biogas, fuel cells.
3. Understand the advantages and limitations of different non conventional energy sources and identify awide variety of applications for non conventional energy.

Course Outcomes: At the end of the course, the student will be able to

CO 1 Understand different methods of exploiting solar energy.
CO 2 Understand the principles and energy conversion from wind and geo thermal sources
CO 3 Gain knowledge in exploring the energy from ocean, tidal and bio-mass
CO 4 Understand the techniques in power generation using Fuel cells, bio gas and MHD

UNIT-I

Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits **Solar Energy:** Extra terrestrial solar radiation - terrestrial solar radiation –solar radiations on earth-measurement of solar radiations-solar constant-solar collectors-flat plate collectors-concentrating collectors-solar thermalconversion-solar thermal central receiver systems - photovoltaic energy conversion - solar cells- energy storage methods-applications of solar energy

UNIT-II

Wind energy: Availability of wind energy in India, site selection-Components of wind energy conversion systems-Classification of wind energy conversion systems-vertical axis and horizontal axis wind turbines- Performance characteristics-Betz criteria coefficient-applications of WECS-environmental aspects

Geo thermal Energy: Structure of earth's interior-geothermal sites-geothermal resources-Site selection for geothermal power plants-Principle of working-various types of geothermal power plants- applications

UNIT-III

Ocean thermal energy conversion (OTEC): Principle of ocean thermal energy conversion-Open cycle andclosed cycle OTEC plants-Merits and demerits

Tidal Power: Tides and waves as sources of energy-fundamentals and use of tidal energy-limitations of tidalenergy conversion system

Bio mass: Availability of biomass and its conversion techniques-bio mass gasification-bio mass resourcedevelopment in India

UNIT-IV

Bio Gas: Bio gas production, aerobic and anaerobic bio conversion process-Properties of bio gas-classificationof biogas plants-advantages and disadvantages-bio gas applications

Fuel Cells: Classification, Principle of working of various types of fuel cells, merits and demerits, future potentialof fuel cells.

Magneto-Hydrodynamics (MHD): Principle of working of MHD Power plant, Classification, advantages anddisadvantages.

TEXT BOOK:

1. Non-Conventional Energy Sources by G.D.Rai, Khanna Publisher, 1998.
2. B H Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw HillEducation Pvt Ltd, 2011

REFERENCE BOOKS:

1. Power plant technology by EL-Wakil, McGraw-Hill, Indian Edition, 2017.
2. Renewable Energy Sources by John Twidell& Toney Weir,3rd Edition, E&F.N. Spon, 2015.
3. H.P. Garg& Jai Prakash, Solar Energy: Fundamentals and Applications, 1st revised Edition,Tata McGraw Hill,New Delhi, 2017.

CO-PO MAPPING

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		2		2			2	1					2	1
CO2			2				2								
CO3		1			1				1			1		1	1
CO4	3		2		2	2				2		2			2

ADVANCED MANUFACTURING PROCESSES
20ME604C-PEII
III Year B.Tech. (Mech) Sixth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To describe and demonstrate different unconventional machining processes
2. To explore the recently developed welding and adhesive bonding processes and their applications
3. To familiarize with the basic concepts of micromachining and different processes with potential applications.
4. To describe the principles and applications of different additive manufacturing processes

Course Outcomes:

Upon successful completion of this course, the student will be able to

CO 1 Understand and learn different unconventional machining processes and choose appropriate process to produce a given component

CO 2 Distinguish the advanced welding processes suitable for various material systems.

CO 3 Differentiate the basic principles of machining and micromachining and select a suitable micromachining process and develop a miniature micro machine tool.

CO 4 Understand the basic mechanisms of additive manufacturing processes and their potential applications in different engineering fields.

UNIT-I

UNCONVENTIONAL MACHINING PROCESSES: Introduction, principles, operation, equipment and applications of abrasive jet machining (AJM), ultrasonic machining (USM), water jet machining (WJM), electric discharge machining (EDM), chemical machining and electrochemical machining (CHM and ECM), electron beam machining (EBM), laser beam machining (LBM) and plasma arc machining (PAM) (12)

UNIT-II

ADVANCED WELDING: Principles, mechanisms and applications of solid state welding, friction welding, friction stir welding, explosion welding, ultrasonic welding, underwater welding, diffusion welding, cold pressure welding and hot pressure welding. (10)

ADHESIVE BONDING: Introduction, classification of adhesives, joint design, methods, applications. (2)

UNIT-III

MICROMACHINING: Introduction, microstructure and material properties, theory of micromachining, chip formation, surface roughness, cutting fluids, principles and applications of micro turning, micro milling, micro drilling, precision grinding, and laser

beam micromachining. Fabrication of micro cutting tools and development of miniature machine tools. (12)

UNIT-IV

ADDITIVE MANUFACTURING: Introduction, CAD in additive manufacturing, liquid based and solid based processes, laser technology, stereo lithography, fused deposition, selective laser sintering, 3D printing technologies, laser engineered net shaping (LENS), principles and applications. (12)

TEXT BOOKS

1. Serope Kalpakjian, Steven Schmid, "Manufacturing engineering & technology", Pearson Education / PHI, 7th editon, 2013.
2. Mikell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", John Wiley, 7th edition, 2019.

REFERENCE BOOKS

1. Madore J, "Fundamental Of Micro Fabrication", CRC Press, 2nd edition, 2002.
2. Sami Franssila, "Introduction To Micro Fabrication", John Wiley And Sons Ltd., UK, 2004.
3. Chua C.K., Leong K.F., And Lim C.S., "Rapid Prototyping: Principles And Applications", Third Edition, World Scientific Publishers, 2010.
4. Vijay Kumar Jain, Advanced Machining Processes, Allied Publishers, 1st edition, 2009.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1			2	1	1			2		2	2	1	3
CO2	2	1		1	2	1			1	2	1	2	2	1	2
CO3	2	1	1	1	2					1	1	2	2		1
CO4	2	1	1	2	3	1			1	2	1	3	2		3

OPERATIONS RESEARCH
20MED604 PE-IID
III Year B.Tech. (Mech)Sixth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To provide an in-depth coverage and applications of Operations Research (O.R) to real-world systems.
2. To understand the concepts of formulation of linear programming problem and its solution.
3. Expose to different O.R models such as Transportation Problems, Assignment Problems, Queuing problems, and Game theory.
4. To enable the students, apply dynamic programming and simulation

Course Outcomes:

At the end of the semester, Students will be able to

CO 1 Realize the importance of operations research & acquire skills to develop linear programming mathematical models and its solution.

CO 2 Analyze and solve typical problems in transportation and Assignment models.

CO 3 Be Proficient with Queuing Theory and game theoretic models

CO 4 Explain Dynamic programming and deterministic and probabilistic models. Also, identify the utility of simulation in engineering applications and solve simple problems in simulation.

UNIT-I

LINEAR PROGRAMMING: Definition, Scope of Operations Research, Mathematical formulation of the problem, Graphical method, Simplex method, Artificial variables techniques: Big-M method, Duality Principle. (12)

UNIT-II

TRANSPORTATION PROBLEM: Introduction, Formulation, Optimal solution, Un balanced transportation problem, Degeneracy. (8)

ASSIGNMENT PROBLEM: Formulation, Hungarian method, Optimal solution, Assignment Problems. (4)

UNIT-III

QUEUING THEORY: Introduction, Characteristics of Queuing models, Single Channel Queuing Theory models with Poisson arrivals and exponential service times with infinite population. (8)

Game Theory: Introduction, 2-person zero sum games, games with saddle point (pure strategy), games without saddle points (mixed strategy), (4)

UNIT-IV

DYNAMIC PROGRAMMING: Introduction toDynamic Programming, Characteristics of Dynamic Programming Problems, Deterministic Dynamic Programming, (8)

SIMULATION: Introduction. Discrete and continuous Simulation, Random number generation, applications. (4)

TEXT BOOKS

1. Operations research by Ravindran, A., Philips, D.T., and Solberg, J.J, 2nd Edition, John Wiley and Sons.1987.
2. Operations Research / H.A. Taha, 10th Edition, Pearson publishers, 2019.

REFERENCE BOOKS

1. Operations Research by Premkumar Gupta & D.S. Hira, 11th Edition,S.Chand & Company Ltd, 2015.
2. Operations Research by Wagner,2nd Edition, PHI Publications, 1980.
3. Operations Research by J K Sharma, 6th Edition, Trinity press,2017.
4. "Introduction to operations Research", by Hiller & Liberman, 10th Edition, TMH publishers, 2017.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	2	1												
CO2	2	1													
CO3	1	2													
CO4	1		2												

HEAT TRANSFER LAB
20MEL601
III Year B. Tech. (Mech) Sixth Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To understand the fundamentals of heat transfer mechanisms both in fluids and solids.
2. To measure the modes of heat transfer through various heat transfer equipment.
3. To understand the working of refrigeration and air conditioning systems.

Course Outcomes:

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

CO 1 Determine the thermal conductivity of insulating powder, composite wall, metal bar and lagged pipe
CO 2 Estimate the rate of heat transfer for Natural and Forced convection apparatus
CO 3 Analyze the performance of parallel and counter flow heat exchangers
CO 4 Evaluate the performance of refrigeration and air conditioning systems

Conduct experiments on Any **Ten** of the Following:

1. Heat Exchanger – Parallel Flow
2. Heat Exchanger – Counter Flow
3. Heat transfer through a Composite Slab
4. Heat transfer through a Metal Rod
5. Critical Heat flux Apparatus
6. Emissivity Apparatus
7. Pin fin – Natural Convection
8. Pin fin – Forced Convection
9. Insulating powder Apparatus
10. Forced Convection Apparatus
11. Stefan – Boltzmann's Apparatus
12. Lagged pipe Apparatus
13. Refrigeration Test Rig
14. Air Conditioning Test Rig

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2		2		1				1			2	2	
CO2	3	2		2		1				1			2	2	
CO3	2	2		2		1				1			2	2	
CO4	2	2		2		1	1			1			2	2	

CAE LAB
20MEL602
III Year B.Tech. (Mech) Sixth Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

To impart the fundamental knowledge on using various CAE software packages like ANSYS, CFD etc., for Engineering Simulation.

To develop the student's skills in proper modelling, meshing, and setting up material properties, loads, and constraints for computer simulation and analysis (e.g. structural, thermal and computational fluid dynamics) and then solve the problem using CAE software packages.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Analyse the one dimensional problems after solving them numerically.
CO2: Acquire knowledge for designing the two dimensional problems and compare results with classical solutions.
CO3: Have hands on experience to model a component or part by analysing it.
CO4: Able to solve buckling, time dependent and harmonic analysis of real life engineering problems.

Course Content:

Analysis of Mechanical Components – Use of FEA Packages like ANSYS/ NASTRAN etc.,
FEA introduction
CAD Import
Types of elements
Meshing – 2D, 3D Meshing
Convergence of mesh size
Defining mesh Joints
Application of Loads and boundary conditions
Solver – Types of analysis
Machine elements under Static loads
Thermal Analysis of mechanical systems
Modal Analysis Machine elements under Dynamic loads
Non-linear systems
Post processing – Viewing FEA results – Stress, deflection, Mode shapes etc.
Interpretation of FEA Results for design validation.
Machine elements under Static loads
Thermal Analysis of mechanical systems

Modal Analysis
Machine elements under Dynamic loads Non-linear systems

References:

1. Introduction to Finite elements in Engineering by Chandrupatla & Belegundu, PHI. 2.
2. www.mece.ualberta.ca.
3. The finite element method and applications in engineering using ANSYS® by Madenci, E., & Guven, I. (2015). Springer.

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	2	2	1								1	2	
CO2	3	3	2	2	1								1	2	
CO3	2	3	2	2	1								1	2	
CO4	3	3	2	2	1								1	2	

CAM LAB
20MEL603
III Year B. Tech. (Mech) Sixth Semester

Lectures	0	Tutorial	0	Practical	3	Credits	1.5
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To write manual part programs for different operations on CNC Lathe.
2. To write manual part programs for different operations on CNC Machining centre.
3. To check the part programs using FANUC Simulation software.
4. Demonstration of parts and operation of CNC Lathe and CNC Machining centre.
5. Modelling of simple parts and generation of part program using MASTER CAM software.

Course Outcomes:

At the end of the course, the student will be able to:

CO 1 Write part programs for step turning, taper turning, profile turning, external and internal threading.
CO 2 Write part program using canned cycles and sub-programs.
CO 3 Write part programs for slot milling, profile milling and drilling.
CO 4 Explain the operation of CNC lathe and Machining centre to produce simple components.

Course Content:

I. Manual Part Programming and tool path simulation using offline simulation software on CNC
Lathe for the following operations.

1) Step turning,
2) Taper turning,
3) Profile turning
4) External threading
5) Drilling, boring and internal threading

II. Manual Part Programming and tool path simulation using offline simulation software on CNC
Machining centre for the following operations.

1) Slot milling.
2) Step milling
3) Diagonal milling.
4) Profile milling.
5) Hexagon milling & drilling.

III. Modeling, Part Program generation and tool path simulation using Master CAM software.

IV. Demo on working of CNC Lathe and CNC Machining centre.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2			2			1	1		2		1		1
CO2	2	2			2			1	1		2		1		1
CO3			1		1			1	1		2			2	1
CO4			1		1			1	1		2			2	1

SOFT SKILLS
20ME606/SS
III Year B. Tech. (Mech) Sixth Semester

Lectures	0	Tutorial	0	Practical	3	Credits	2
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course content:

1. BODY LANGUAGE & IDENTITY MANAGEMENT

a. Facial Expressions – Kinesics - Occulesics
b. Haptics - Proxemics
c. Para Linguistics
d. Appearance
e. Identity Management Communication

2. EMOTIONAL INTELLIGENCE & LIFE SKILLS

a. Self Awareness through Johari Window and SWOC analysis
b. Self Motivation
c. Empathy
d. Assertiveness& Managing Stress
e. Positive Attitude
f. Time Management
g. Goal Setting: Short term, Long Term, Vision, Mission.

3. BUSINESS PRESENTATIONS

a. Preparing effective Presentations Power Point Presentations
b. Power Point Presentations
c. Using Visual Aids
d. Mock Presentations

4. EMPLOYABILITY SKILLS

a. Group Discussion
b. Team Building and Leadership Qualities
c. Interview Skills

Reference Books:

- Personality Development and Soft skills (Second Edition), Barun K. Mithra. Oxford University Press: 2016
- The Definitive Book of Body Language, Allan & Barbara. Pease International:2004
- Working with Emotional Intelligence, Daniel Goleman. Bloomsbury:1998
- English for Jobseekers, Lina Mukhopadhyay. Cambridge University Press:2013
- The 7 Habits of Highly Effective People, Stephen R.Covey. St. Martin's Press:2014

Course Objectives

The course aims

1. to make the engineering students aware of the importance, the role and the content of soft skills through instruction, knowledge acquisition, demonstration and practice.
2. to know the importance of interpersonal and intrapersonal skills in an employability setting
3. actively participate in group discussions / interviews and prepare & deliver presentations
4. function effectively in multi-disciplinary and heterogeneous teams through the knowledge of team work, Inter-personal relationships, stress management and leadership quality

Course Outcomes

By the end of the course the students would be able to

CO 1 Use appropriate body language in social and professional contexts

CO 2 Demonstrate different strategies in presenting themselves in professional contexts

CO 3 Analyze and develop their own strategies of facing the interviews successfully

CO 4 Develop team coordinating skills as well leadership qualities

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1								1	2	3	1	2	2	1	1
CO2								1	1	3	1	2	2	1	1
CO3								1	1	3	1	2	2	1	1
CO4								1	3	3	1	3	2	1	1

CONSTITUTION OF INDIA
20ME607/MC
II Year B.Tech. (Mech) Third Semester

Lectures	2	Tutorial	0	Practical	0	Credits	0
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			0

Course Objectives:

1. To provide basic information about fundamental law of the country.
2. To educate the student about fundamental Rights and fundamental duties of citizens.
3. To educate the students about Government organs, methods of functioning
4. To motivate students to leave narrow selfish outlook and inculcate broad national, human outlook.

Course Outcomes:

CO 1 Understand the importance of the constitution in a Democratic Society
CO 2 Understand the Fundamental Rights, Duties of a citizen by discharging his duties to become a good citizen.
CO 3 Remember about Judicial supremacy and Independence of judiciary and fight for his legitimate Rights through court of law.
CO 4 Applying the principles to participate in the democratic process of governance and in nation building activities.

UNIT-I

1. Meaning of the constitutional law and constitutionalism.
2. Historical perceptive of the constitution of India
3. Salient features and characteristics of the constitution of India.
4. Preamble, union and its territory and citizenship.

UNIT-II

1. Fundamental rights principles.
2. Directive principles of state policy.
3. Fundamental Duties.
4. The government of the union, the president, The Prime Minister, and the council of ministers, The parliament of India, The supreme court, the union judiciary

UNIT-III

1. The Machinery of Government in the states, The Governor, The Chief Minister and council of Ministers, The State legislature, High court, Judiciary in the states
2. Union territories.
3. The Federal System, Division of powers between centre and states, Legislative Administration and financial relation.
4. Emergency Provisions, President Rule, National Emergency, Financial Emerging
5. Local self-Government, Panchayat Raj, Municipalities and municipal Corporation.

UNIT-IV

1. Local self-Government, Panchayat Raj, Municipalities and municipal Corporation

2. Miscellaneous Provisions, the comptroller and Auditor general of India, The Public Service Commission, Special Provisions relating to certain classes, Elections – Political parties.
3. Amendment of the Constitution.

TEXT BOOKS

1. Introduction to constitution of India, D.D.Basu, 24th Edition, Lexis Nexus, 2019.
2. The constitution of India by P.M.Bhakshi, 18th Edition,Universal law publishing,2021.

REFERENCE BOOKS

1. Constitutional Government in India - M V Pylee , Kindle Edition,Asia Publishing House, 2004.
2. Indian Government and Politics – D C Dasgupta,8th Edition,Vikas Publishing house, 2007.
3. The Oxford Hand Book of the Indian Constitution, Sujit Chowdary, Madhav Khosla Pratapabhem Mehla,oxford university press UK,2016.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1						3	3	2	3			3			
CO2						3	1	2	1			3			
CO3						3	1	2	1			3			
CO4						3	3	2	3			3			

JOB ORIENTATED COURSES

JAVA PROGRAMMING
III B.Tech. Fifth Semester

Lectures	2	Tutorials	0	Practical	2	Credits	3
Continuous internal Assessment			30	Semester End Examination			70

Pre-Requisite: None.

Course Objectives:

1. Understand the concepts of Data Types, Variables, Arrays, Operators, control Statements, Classes and Objects.
2. Understand Inheritance, Interfaces, Packages and Strings.
3. Understand and write programs on Exception Handling and I/O.
4. Understand the concepts of Event Handling, Applets and Swings.

Course Outcomes: Students will be able to:

- CO1 Understand basic Java language syntax and semantics to write Java programs, use concepts such as variables, conditional and iterative execution methods etc. And use the Java SDK environment to create, debug and run Java programs
- CO2 Identify classes, objects, members of a class and relationships among them needed for a specific problem and Write Java application programs using OOP principles and proper program structuring
- CO3 Demonstrate the concepts of polymorphism, inheritance, packages and interfaces.
- CO4 Write Java programs to implement error handling techniques using exception handling

UNIT-1

The History and Evolution of Java, An Overview of Java, Data Types, Variables and Arrays, Operators, Control Statements, Introducing Classes A Closer Look at Methods and Classes. (12)

UNIT-2

Inheritance, Packages and Interfaces.

Strings: String Constructors, Program using 10 String methods, String Buffer class, Program using 10 String Buffer methods Introducing String Builder class. (12)

UNIT-3

Exception Handling

I/O: I/O Basics, Reading Console Input, Writing Console Output, The Print Writer class, Reading and Writing Files, Automatically Closing a File. (12)

UNIT-4

The Applet Class: Applet Architecture, An Applet Skeleton, Applet program to draw shapes, setting Color, Font using Graphicsclass

Event Handling, GUI Programming with Swing: The Origins of Swing, Advantages of Swing over AWT, The MVC Connection, Program using Swing Components JLabel, JText Field, JText Area, JCheck box, JButton, JTabbed Pane, JTable, JTree, JCombo Box. (12)

Text Books :

1. Java The Complete Reference‖, 9th Edition, Herbert Schildt, TMH Publishing Company Ltd.

References :

1. Java: A Beginner's Guide, Eighth Edition, Herbert Schildt, TMH Publishing Company Ltd.
2. Head First Java, Second Edition, O'Reilly

DATABASE MANAGEMENT SYSTEM
III B.Tech. Fifth Semester

Lectures	3	Tutorials	0	Practical	0	Credits	3
Continuous internal Assessment			30	Semester End Examination			70

Course Objectives:

At the end of the course, the students will be able to:

1. Familiarize with fundamental concepts of database and various database architectures and Design relations for Relational databases using conceptual data modeling. Familiarize the student with the basic taxonomy and terminology of the computer networking area.
2. Implement formal relational operations in relational algebra and SQL.
3. Identify the Indexing types and normalization process for relational databases
4. Use mechanisms for the development of multi user database applications

Learning Outcomes:

After completing this course the student must demonstrate the knowledge and ability to:

1. Ability to apply knowledge of database design methodology which give a good formal foundation in relational data model and Understand and apply the principles of data modeling using ER Model.
2. Familiar with relational DB theory and will able to write relational algebra expressions, Relational Calculus and SQL.
3. Design database schema and Identify and solve the redundancy problem in database tables using normalization.
4. Understand transaction processing and concurrency control techniques.

UNIT-I

Databases and Database Users: Introduction - An Example - Characteristics of the Database Approach– Actors on the Scene- Workers behind the Scene-Advantages of Using the DBMS Approach.

Database System Concepts and Architecture: Data Models, Schemas, and Instances- Three-Schema Architecture and Data Independence- Database Languages and Interfaces- The Database System Environment -Centralized and Client/Server Architectures for DBMSs.

Data Modeling Using the Entity-Relationship(ER)Model: Using High-Level Conceptual Data Models for Database Design-An Example Database Application-Entity Types, Entity Sets, Attributes, and Keys-Relationship Types, Relationship Sets, Roles, and Structural Constraints-Weak Entity Types-Refining the ER Design for the COMPANY Database-ER Diagrams, Naming Conventions, and Design Issues (12)

UNIT-II

The Relational Algebra and Relational Calculus: Unary Relational Operations: SELECT and PROJECT - Relational Algebra Operations from Set Theory-Binary Relational Operations: JOIN and DIVISION– Additional Relational Operations-The Tuple Relational Calculus-The Domain Relational Calculus

Schema Definition, Constraints, Queries, and Views: SQL Data Definition and Data Types –Specifying Constraints in SQL-Schema Change Statements in SQL-Basic Queries in SQL – More Complex SQL Queries-INSERT, DELETE, and UPDATE Statements in SQL- Views (Virtual Tables) in SQL (12)

UNIT-III

Introduction to Schema Refinement: Problems Caused by Redundancy, Decompositions– ProblemRelated to Decomposition, Functional Dependencies - Reasoning about FDS, Normal Forms, FIRST, SECOND, THIRD Normal Forms, BCNF, Properties of Decompositions, Loss Less- Join Decomposition, Dependency Preserving Decomposition, Schema Refinement in Database Design – Multivalued Dependencies FOURTH Normal Form, Join Dependencies, FIFTH Normal form, Inclusion Dependencies. (12)

UNIT-IV

Introduction to Transaction Processing Concepts and Theory: Introduction to Transaction Processing-Transaction and System Concepts-Desirable Properties of Transactions- Characterizing Schedules Based on Recoverability –Characterizing Schedules Based on Serializability

Concurrency Control Techniques: Two-Phase Locking Techniques for Concurrency Control –Concurrency Control Based on Time stamp Ordering– Multi version Concurrency Control Techniques-Validation(Optimistic) Concurrency Control Techniques-Granularity of Data Items and Multiple Granularity Locking (12)

Text Book(s) : Fundamentals of Database Systems, RamezElmasri and Navathe Pearson Education, 6thedition

References :

1. Introduction to Database Systems, C.J. Date Pearson Education
2. Database Management Systems, Raghu Rama krishnan, Johannes Gehrke, TATA McGraw Hill3rdEdition
3. Database System Concepts, Silberschatz, Korth, McGraw hill,5thedition

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1		3	2	2		2				3			2		3
CO2	3	3	2	2						3			3	3	3
CO3	3	3	3	3						3			3	3	3
CO4		3	3	3		3				3			2	3	3

Introduction to Data Analytics
III B.Tech. Fifth Semester

Lectures	3	Tutorials	0	Practical	0	Credits	3
Continuous internal Assessment			30	Semester End Examination			70

Prerequisites:

Course Objectives: Students will be able to:

1: Understand the use of R, Basics of R, Advanced data structures, reading/writing data into
2: Understand the basic & advanced data management, manipulate data using SQL statements
and visualization of data using different plots.
3: Understand the normal, binomial distributions, correlation and covariance, T-test, ANOVA,
Manipulation string, and Linear models.
4: Understand the cluster analysis and classification.
Course Outcomes: After the course the students are expected to be able to:

CO 1: Import, review, manipulate and summarize data-sets in R.
CO 2: Understand advanced data structures like vectors, lists, matrices, arrays and data frame.
CO 3: Understand normal and binomial distributions and apply basic and advanced statistical tools.
CO 4: Understand the difference between Supervised and Un-supervised Machine Learning Algorithms.

Syllabus:

UNIT – I

Introduction to R - Why use R?, Obtaining and installing R, The R Environment - Command line interface, RStudio, R Packages - Installing packages, loading packages, Building packages, Basics of R - basic Math, variables, Data types, vectors, calling function, function documentation, missing data. Advanced Data Structures- data.Frames, Lists, Matrices, Arrays, Reading Data into R-Reading CSVs, Excel data, reading from databases.

(12)

UNIT – II

Basic Data Management - A working example, creating new variables, recoding variables, renaming variables, missing values, date values, type conversion, sorting data, merging data set, sub-setting datasets, Using SQL statement to manipulate data.

(12)

UNIT – III

Normal distribution, binomial distribution, summary statistics, correlation and covariance, T-test, ANOVA, paste, sprintf, extracting text, regular expression, Simple linear regression, multiple linear regressions.

(12)

UNIT – IV

Cluster Analysis-common steps in cluster analysis, calculating distances, Hierarchical cluster analysis, Partitioning cluster analysis, avoiding nonexistence clusters, Preparing the data,

logistic regression, decision trees, random forests, support vector machines, choosing a best predictive solution. (12)

TEXT BOOK:

1. R for Every One, Advanced analytics and graphics by Jared P Lander, Addison Wisley Data and Analytics series, 2017, 2nd edition.
2. R in Action, Data Analysis and graphics with R, Robert L Kaacoff, Manning Publisher,2015, 2nd edition.

REFERENCE BOOKS:

1. Beginning R by Dr.Mark Gardener, Wrox publisher, 2012, 1st edition.
2. Associate Analytics Facilitator Guide provided by NASSCOM. http://183.82.43.252/~gopam/html/NASSCOM.

CO PO Mapping

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
CO 1	2						1							1	2
CO 2				3	2									1	2
CO 3				3	2									1	2
CO 4				3	2									1	2

Python Programming
III B.Tech. Fifth Semester

Lectures	2	Tutorials	0	Practical	2	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. Understand and write code using the basics of Python, statements, Expressions, Conditional Executions and Functions.
2. Write Code for iteration, String and F/O
3. Write code in creating, usage of Lists, Dictionaries and Tuples.
4. Understand the concepts of Object Orientation and write code to implement them.

Course Outcomes : At the end of the Course the student will be able to

CO 1 Understanding of scripting and the contributions of Python language

CO 2 Understanding of Conditional Execution and Functions in Python language.

CO 3 Implement File handling operations also can work with different data types in Python.

CO 4 Implement Object oriented concepts.

UNIT- I

Introduction: Overview, History of Python, Python Features, Environment Setup. Variables, expressions, and statements: values and types, variables, names and keywords, statements, operators and operands, expressions, order of operations, modulus operator, string operations, asking the user for input, comments, choosing mnemonic variable names.

Conditional execution: Boolean expressions, logical operators, conditional execution, Alternative execution, chained conditionals, nested conditionals, catching exceptions using try and except, short-circuit evaluation of logical expressions.

Iteration: updating variables, the while statement, infinite loops and break, finishing iterations with continue, definite loops using for, loop patterns.

UNIT- II

Functions: function calls, built-in functions, type conversion functions, random numbers, math functions, adding new functions, definitions and uses, flow of execution, parameters and arguments, fruitful functions and void functions.

Strings: string is a sequence, getting the length of a string using len, traversal through a string with a loop, string slices, strings are immutable, looping and counting, the in operator, string comparison, string methods, parsing strings, format operator.

Files I/O: persistence, opening files, text files and lines, reading files, searching through a file, letting the user choose the file name, using try except and open, writing files.

UNIT- III

Lists: a list is a sequence, lists are mutable, traversing, operations, slices, methods, deleting elements, functions, strings, parsing lines, objects and values, aliasing, arguments.

Dictionaries: dictionary as a set of counters, dictionaries and files, looping and dictionaries, advanced text parsing.

Tuples: tuples are immutable, comparing tuples, tuple assignment, dictionaries and tuples, multiple assignment with dictionaries, the most common words, using tuples as keys in dictionaries, sequences.

UNIT-IV

Regular expressions: character matching in regular expressions, extracting data using regular expressions, combining searching and extracting, escape character.

Object-Oriented Programming: Managing Larger Programs, Using Objects, starting with Programs, Subdividing a Problem–Encapsulation, First Python Object, Classes as Types, Object Lifecycle, Many Instances, Inheritance.

LIST OF EXPERIMENTS

1. Write a python program to check if the number is positive or negative or zero and display an appropriate message.
2. Write a python program to take a string from the user and count the number of vowels present and percentage of vowels in it.
3. Write a python program to find the most frequent words in a text file.
4. Write a Python Program to Find the Sum of First n Natural Numbers.
5. Write a python program to find the numbers which are divisible by 7 and multiple of 5 between 1500 and 2700
6. Write a Python Program to solve Quadratic Equations.
7. Create a program that asks the user for a number and then prints out a list of all the divisors of that number.
8. Write a Python Program to Find HCF or GCD.
9. Write a Python Program to Find LCM.
10. Write a Python program to construct the following pattern, using a nested loop number.
11. Write a Python Program to sort the given words in Alphabetical Order.
12. Write a Python function to create the HTML string with tags around the word(s).
13. Write a Python program to reverse words in a string.
14. Write a Python program to strip a set of characters from a string.
15. Write a python function to find the maximum and minimum of a list of numbers.
16. Write a Python Program to Find the Square Root.
17. Write a Python Program to Convert Decimal to Binary Using Recursion.
18. Write a python recursive function to find the factorial of a given number.
19. Write a python program to find the longest word in each line of a given file.
20. Write a Python program to combine each line from the first file with the corresponding line in the second file.
21. Write a Python program to read a random line from a file.
22. Write a Python program to split a list every Nth element.
    Sample list: ['a', 'b', 'c', 'd', 'e', 'f', 'g', 'h', 'i', 'j', 'k', 'l', 'm', 'n']
    Expected Output: [['a', 'd', 'g', 'j', 'm'], ['b', 'e', 'h', 'k', 'n'], ['c', 'f', 'i', 'l']]
23. Write a Python program to compute the similarity between two lists.
    Sample data: ["red", "orange", "green", "blue", "white"], ["black", "yellow", "green", "blue"]
    Expected Output:
    Color1-Color2: ['white', 'orange', 'red']
    Color2-Color1: ['black', 'yellow']
24. Write a Python program to replace the last element in a list with another list.
    Sample data: [1, 3, 5, 7, 9, 10], [2, 4, 6,8]

Expected Output: [1, 3, 5, 7, 9, 2, 4, 6, 8]

25. Write a Python program to find the repeated items of a tuple.
26. Write a Python program to convert a list with duplicates to a tuple without duplicates.
27. Write a Python program to reverse the elements of a tuple.
28. Write a Python program to replace the last value of tuples in a list.
    Sample list: [(10, 20, 40), (40, 50, 60), (70, 80, 90)]
    Expected Output: [(10, 20, 100), (40, 50, 100), (70, 80, 100)]
29. Write a Python program to combine two dictionaries by adding values for common keys.
    d1 = {'a': 100, 'b': 200, 'c':300}
    d2 = {'a': 300, 'b': 200, 'd':400}
    Sample output: Counter({'a': 400, 'b': 400, 'd': 400, 'c': 300})
30. Write a Python program to create and display all combinations of letters, selecting each letter from a different key in a dictionary.
    Sample data : {'1':['a','b'], '2':['c','d']} Expected Output:
    ac
    ad
    bc
    bd
31. Write a Python program to get the top three items in a shop.
    Sample data: {'item1': 45.50, 'item2':35, 'item3': 41.30, 'item4':55, 'item5': 24}
    Expected Output:
    item4 55
    item1 45.5
    item3 41.3
32. Write a Python program to match both key values in two dictionaries.
    Sample dictionary: {'key1': 1, 'key2': 3, 'key3': 2}, {'key1': 1, 'key2': 2}
    Expected output: key1: 1 is present in both x and y
33. Write a Python class named Rectangle constructed by a length and width and a method which will compute the area of a rectangle.
34. Write a Python class named Circle constructed by a radius and two methods which will compute the area and the perimeter of a circle.
35. Write a Python program to create a Single Linked List using classes.
36. Write a Python program to create a FIFO queue using classes.
37. Predict the output of following Python programs and write the justification.

```
class X(object):
    def __init (self,a):
        self.num = a
    def doubleup(self):
        self.num *= 2
class Y(X):
    def __init (self,a):
        X. init (self,a)
    def tripleup(self):
        self.num *= 3
obj = Y(4)
print(obj.num)
obj.doubleup()
print(obj.num)
```

```
obj.tripleup()
print(obj.num)
```

38. Predict the output of following Python programs and write the justification.

```
# Base or Super class
class Person(object):
    def __init (self, name):
        self.name = name
    def getName(self):
        return self.name
    def isEmployee(self):
        return False
# Inherited or Subclass (Note Person in bracket)
class Employee(Person):
    def __init (self, name, eid):
        '''In Python 3.0+, "super().__init__(name)"also works'''
        super(Employee, self).__init__(name)
        self.empID = eid
    def isEmployee(self):
        return True
    def getID(self):
        return self.empID
# Driver code
emp = Employee("Geek1", "E101")
print(emp.getName(), emp.isEmployee(), emp.getID())
```


Text Books : 1.A Python Book: Beginning Python, Advanced Python, and Python Exercises, Dave Kuhlman, Open Source MIT License.
2.Python for Data Analysis, Wes McKinney, O‟ Reilly.

References : 1. Python Data Science Handbook-Essential Tools for Working with
2. Data Science from Scratch, JoelGrus, O‟Reilly.

INSPECTION AND QUALITY CONTROL
III B.Tech. Fifth Semester

Lectures	3	Tutorials	0	Practical	0	Credits	3
Continuous internal Assessment			30	Semester End Examination			70

Course Objectives:

1. To provide students an insight into the concepts of inspection and Non-destructive Inspection
2. To make the students to understand the concepts of quality and quality improvement tools
3. To provide the students with an understanding basics of statistical quality control and control charts for variables
4. To study the control charts for attributes and acceptance sampling

Course Outcomes:

Student will be able to

CO 1 Understand the inspection, types and principles of inspection along with Non-destructive Inspection

CO 2 Understand the quality concepts and quality improvement techniques

CO 3 Understand the basics of SQC and gain knowledge on control charts for variables

CO 4 Understand the basics of control charts for attributes and gain knowledge on acceptance sampling

UNIT I

Introduction to inspection, Role of inspection and measurement for quality control in manufacturing, Need of inspection, Inspection types and principles, Design for inspection, Destructive inspection.

Non-destructive Inspection: Visual inspection, Dye-penetrant inspection, Magnetic particle inspection, Eddy current inspection, Ultrasonic testing.

(12)

UNIT II

Quality definitions - Quality Dimensions - Quality control - Quality Assurance – Quality planning - Quality costs -analysis of quality costs - Economics of quality - Quality loss function- quality improvement- Taguchi methods - total quality tools - pare to chart - fishbone diagram - check sheet - histograms - scatter diagrams - run charts - flow diagram - Bench Marking-Quality circles. (12)

UNIT - III

QUALITY CONTROL FOR VARIABLES

Definition of SQC, benefits and limitation of SQC, Quality assurance - Concepts of Quality control -Quality cost-Variation in process- factors – process capability – process capability studies and simple problems – Theory of control chart- uses of control chart – Control chart for variables – X bar chart, R chart, X bar and S charts– six sigma concept

(12)

UNIT – IV

PROCESS CONTROL FOR ATTRIBUTES

Control chart for proportion or fraction defectives – p chart and np chart – control chart for defects – C and U charts, State of control and process out of control identification in charts – Acceptance sampling plan – Types - O.C. curves – producer's Risk and consumer's Risk.AQL, LTPD, AOQL concepts-standard sampling plans for AQL and LTPD- uses of standard sampling plans. (12)

Text Books

1. SHARMA S.C., "Inspection Quality Control and Reliability", Khanna Publishers, 2002.
2. MONOHAR MAHAJAN, "Statistical Quality Control", Dhanpat Rai & Sons, 2001.

Reference Books

1.R.C.GUPTA, "Statistical Quality control", Khanna Publishers, 9th edition, 1998.
2.BESTERFIELD D.H., "Quality Control", Prentice Hall, 7th edition, 2003.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1									1	2	3				1
CO2						2			3		1				1
CO3									3	2	1	2			1
CO4	2	3	2	3			2								

SUPPLY CHAIN ANALYTICS
III B.Tech. Fifth Semester

Lectures	3	Tutorials	0	Practical	0	Credits	3
Continuous internal Assessment			30	Semester End Examination			70

Course Objectives:

1. To provide students an insight into the fundamental concepts of supply chain and their strategies
2. To make the students to understand the concepts of supply chain network design
3. To provide the students with an understanding basics of logistics in supply chain
4. To study the supply chain drivers and forecasting techniques.

Course Outcomes:

Student will be able to

CO 1 Ability to build and manage a competitive supply chain using strategies, models, techniques and information technology.
CO 2 Understand the supply chain network design
CO 3 Understand and gain knowledge on logistics in supply chain
CO 4 Analyze supply chain dynamics and various issues of supply chain performance.

UNIT-I INTRODUCTION

Role of Logistics and Supply chain Management: Scope and Importance- Evolution of Supply Chain - Decision Phases in Supply Chain - Competitive and Supply chain Strategies. (12)

UNIT-II SUPPLY CHAIN NETWORK DESIGN

Role of Distribution in Supply Chain – Factors influencing Distribution network design – Design options for Distribution Network Distribution Network in Practice-Role of network Design in Supply Chain – Framework for network Decisions. (12)

UNIT-III LOGISTICS IN SUPPLY CHAIN

Role of transportation in supply chain – factors affecting transportations decision – Design option for transportation network – Tailored transportation – Routing and scheduling in transportation. (12)

UNIT-IV SUPPLY CHAIN PERFORMANCE DRIVERS AND FORECASTING

Drivers of supply chain performance - Logistics drivers (Location, inventory and transportation) –Cross functional drivers (Pricing, information and sourcing) – Forecasting introduction -Framework for a forecast system - Choosing right forecasting technique - Judgment methods (Composite Forecasts, Surveys, Delphi Method) – Causal methods (Regression Analysis –Linear Regression) - Time series analysis (Autoregressive Moving Average (ARMA), Exponential Smoothing. (12)

TEXT BOOKS:

1. Sunil Chopra, Peter Meindl, Supply Chain Management: Strategy, Planning, and Operation,
Pearson, 2010.
2. Janat Shah, Supply Chain Management, Pearson Education India, 2009

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		1	3	2		3			2	1	2		1		2
CO2			3			1	2		1		2				2
CO3		3			2		2		2	3	2	1		1	3
CO4	1	2	3	1			3			2					

References Books:

1. Supply Chain management, Chandrasekaran,N., Oxford University Publications, 2010
2. Supply Chain Management for The 21st Century by B S SAHAY. Macmillan Education, 2001

Industrial Safety Engineering
III B.Tech. Fifth Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment	:	30	Semester End Examination (3 Hours)	:	70		

COURSE OBJECTIVES

The student will be able

1. to acquire the skills for identifying and preventing the industrial accidents.
2. to solve problems on Hazard and Risk assessment techniques.
3. to design the safety at workplace including fire safety.
4. to hone the knowledge of Safety standards used in industries.

COURSE OUTCOMES

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

CO 1. study the industrial accidents and prevent them.

CO 2. apply the Hazard and Risk assessment techniques in industries .

CO 3. study the design considerations for safety at workplace and prevent fire hazards.

CO 4. apply the safety standards to design a safe work environment.

UNIT-I

Introduction: Concept of an accident, reportable and non reportable injuries, unsafe act and condition – principles of accident prevention, Supervisory role - Role of safety committee – Accident causation models – Domino theory, Swiss Cheese Accident Models, Cost of accident, Overall accident investigation process - Response to accidents, Calculation of accident indices - frequency rate, severity rate, frequency severity incidence, incident rate, accident rate, salient points of factories act 1948 for health and safety.

(12)

UNIT-II

Hazard and Risk assessment techniques: Understanding of hazard and risk, Hazard evaluation techniques - Checklist analysis, preliminary hazard analysis (PHA), Fault Tree Analysis & Event Tree Analysis, Logic symbols, methodology, various indices – what-if analysis/checklist analysis - hazard operability studies (HAZOP) -Hazard analysis (HAZAN) - Failure Mode and Effect Analysis (FMEA)

(12)

UNIT-III

Safety in Workplace: Plant / Work area Design – Hand tools and Portable power tools – Manual and Mechanical Material Handling – Ergonomics – Machine Guarding. **(6)**

Fire Safety in industries: Fire safety: Fire Chemistry and its Physics, Fire triangle, Fire Protection, Prevention and Control, Laws and Regulations – Relevant Provisions of Factories Act and Rules. **(6)**

UNIT-IV

Safety standards: Personal protection - Concepts of personal protective equipment – selection of PPE – ergonomic considerations in PPE design. Housekeeping – Concept of 5S and its significance. OHSAS 18000 - Structure and features of OSHAS 18001 – Benefits of certification-certification procedure, Guidelines (18002:2000) for implementing OHSAS 18001, Factories act and rules - Workmen compensation act, Manufacture, Storage and Import of Hazardous Chemical rules 1989, Indian Electricity act and rules.

(12)

Text Books:

1. Heinrich H.W. "Industrial Accident Prevention" McGraw-Hill Company, New York, 1980.
2. Petersen D. Techniques for safety management - A systems approach, ASSE 1998.

Reference Books

1. John Ridley, "Safety at Work", Butterworth & Co., London, 1983..
2. K.C. Arora, ISO 9000 to OHSAS 18001, S.K. Kataria and Sons, Delhi.
3. H. Probabilistic Risk Assessment for Engineering and Scientists, Komamoto and Henley, IEEE Press, 1995.

Web resources:

1. https://nptel.ac.in/courses/110/105/110105094/
2. https://www.youtube.com/watch?v=Rr-xFmErOTk

Mapping of COs

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO 3
CO1	3	2	2	1		3		2	1			1	2		
CO2	2	3	3	3	1	2		1		2		1	3	2	
CO3	3		2			2		2	2			1	3	2	
CO4	3		1			2		2	1			1	2	1	

Industry 4.0
III B.Tech. Fifth Semester

Lectures	3	Tutorials	0	Practical	0	Credits	3
Continuous internal Assessment			30	Semester End Examination			70

Course Objectives:
The students will be able to:

1. Understand the scope of Industry 4.0 in Indian Industry
2. Understand the conceptual framework of Industry 4.0
3. Design the use of robotic technology and Augmented reality in Industry 4.0
4. Hone the knowledge of obstacles and framework conditions in Industry 4.0

Course Outcomes:
Student will be able to

CO 1 Describe Industry 4.0 and scope for Indian Industry
CO 2 Demonstrate conceptual framework and road map of Industry 4.0
CO 3 Describe Robotic technology and Augmented reality for Industry 4.0
CO 4 Demonstrate obstacle and framework conditions for Industry 4.0

UNIT I
Introduction to Industry 4.0:
Introduction, core idea of Industry 4.0,origin concept of industry 4.0,Industry 4.0 production system, current state of industry 4.0, Technologies, How is India preparing for Industry 4.0 (6)
A Conceptual Framework for Industry 4.0:
Introduction, Main Concepts and Components of Industry 4.0, State of Art, Supportive Technologies, Proposed Framework for Industry 4.0.
(6)
UNIT II
Technology Roadmap for Industry 4.0 :
Introduction, Proposed Framework for Technology Roadmap, Strategy Phase, StrategyPhase, New Product and Process Development Phase.
(6)
The Role of Augmented Reality in the Age of Industry 4.0:
Introduction, AR Hardware and Software Technology, Industrial Applications of AR. (6)

UNIT - III
Advances in Robotics in the Era of Industry 4.0:
Introduction, Recent Technological Components of Robots- Advanced Sensor Technologies, Internet of Robotic Things, Cloud Robotics, and Cognitive Architecture for Cyber-Physical Robotics, Industrial Robotic Applications- Manufacturing, Maintenance and Assembly. (12)
UNIT – IV
Obstacles and Framework Conditions for Industry 4.0 :
Lack of A Digital Strategy alongside Resource Scarcity, Lack of standards and poor data security, Financing conditions, availability of skilled workers, comprehensive broadband infra- structure, state support, legal framework, protection of corporate data, liability, handling personal data. (12)

Text Books

1. Alp Ustundag and Emre Cevikcan,"Industry 4.0: Managing the Digital Transformation".
2. Bartodziej, Christoph Jan,"The Concept Industry 4.0".

Reference Books

1. 1. Klaus Schwab,"The Fourth Industrial Revolution".
2. Christian Schröder ,"The Challenges of Industry 4.0 for Small and Medium-sized Enterprises".

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1	1	1	1									1	1	
CO2	2	1				2	1						2		
CO3			3		3			1	2					1	1
CO4	2	2		3		1				2			1	1	

OPEN ELECTIVE COURSES

AUTOMOBILE ENGINEERING

IV Year B.Tech. (Mech) Seventh Semester

Lectures	.3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

To make the students to

1. Familiarize the fundamentals of Engine Components, Chassis and suspension system, braking and transmission system, and cooling and lubrication system.
2. Develop a strong base for understanding future developments like hybrid and electric vehicles in the automobile industry.

Course Outcomes:

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

1. List different types of Vehicles and their applications.
2. Define working of Automobile Engine cooling and lubrication system.
3. Describe functioning of Ignition system and its accessories.
4. Describe functioning of Transmission, Steering, and Braking and Suspension system

UNIT-I

INTRODUCTION: Classification of vehicles – applications, valves, valve arrangements and operating Mechanisms, Piston - design basis, types, piston rings, firing order; Crankshafts, Flywheel, Air and Fuel Filters, Mufflers. (8)

FUEL SUPPLY SYSTEMS: Fuel supply pumps, Mechanical and Electrical type Diaphragm pumps. (3)

COOLING SYSTEMS: Need for cooling system, Air and water cooling, Thermal syphon cooling systems (4)

UNIT-II

LUBRICATING SYSTEMS: Various lubricating systems for I.C. Engines. (3)

ELECTRICAL SYSTEM: Ignition system, Spark plugs, Distributor, Electronic Ignition, Alternator, cutout, Current and voltage regulators, charging circuit, starting motors, lighting, instruments and accessories. (9)

CHASSIS: Introduction, Construction, Requirements of Chassis. (3)

UNIT-III

TRANSMISSION: Gear Box - Theory, Four speed and Five Speed Sliding Mesh, Constant mesh & synchromesh type, selector mechanism, automatic transmission, overdrive, propeller shaft, differential - principle of working. (8)

SUSPENSION SYSTEMS: Need for suspension systems, springs, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment. (7)

UNIT-IV

VEHICLE CONTROL: Steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic). (6)

ELECTRIC, HYBRID AND FUEL CELL VEHICLES: Layout of electric and hybrid vehicles – Advantages and drawbacks, System Components, Electronic control system, Different configurations of electric and hybrid vehicles hybrid vehicles, Power split device, High energy and power density batteries – Basics of fuel cell vehicles. (9)

TEXT BOOKS

1. Automobile Engineering - G.B.S.Narang.
2. Automobile Engineering -R.B.Gupta

REFERENCE BOOKS

1. Automotive Mechanics - Joseph Heitner
2. Automobile Engineering -S. Srinivasan
3. Automobile Engineering - Vol I & II - Kirpal Singh

CO-PO MAPPING

Course Outcomes	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**	**PO 11**	**PO 12**	**PSO 1**	**PSO 2**	**PSO 3**
CO1	2	2										2	1		
CO2	3	2	1		2	2		2		3		2	2	2	
CO3	3	2	2	1						2		2	2	1	1
CO4	2	3	3	2	2	2	3		1		1	2	2	2	3

PROJECT MANAGEMENT

IV Year B.Tech. (Mech) Seventh Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

The course is aimed at project planning and control before implementing any project.
The objectives are,

1. To acquire the knowledge of planning a project.
2. To perform SWOT analysis of project
3. To use PERT and CPM techniques in implementing a project
4. To learn to manage a project
5. To control the project and evaluate it.

Course Outcomes:

At the end of the course, the student will be able to

1. Develop work breakdown structure
2. Apply critical path, risk analysis using PERT Methods
3. Apply scheduling of resources for a given project purpose relevant cost
4. Develop organisation structure for a project &identify the appropriate leadership style

UNIT - I

Introduction to Project Management - Definitions, scope and contents, Relevance, Classification of Projects, Defining the Project,Project Life Cycle, WBS, Project Life cycle, Developing a project Plan, Network analysis, Exercises (14)

UNIT - II

Critical path method, Risk analysis, PERT; problems, Reducing Project Duration (14)

UNIT - III

Estimating project Times and Costs, Scheduling Resources and Costs, problem solving, Progress and Performance Measurement (14)

UNIT - IV

Organization – Structure and Culture, Designing a structure for a project, Leadership styles, Leading, Managing Project Teams. The Project Management Maturity Model (PMMM) (14)

TEXT BOOKS

1. Harold Kerzner, "*Project Management*", 8th Edition, Wiley, New York, 2003. (pdf available)
2. Project Management: The Managerial Process, Erik W. Larson, and Clifford F. Gray. McGraw-Hill Higher Education

REFERENCE BOOKS

1. A Guide to the Project Management Body of Knowledge (PMBOK guide), PMI, 2017

2. Prasanna Chandra, "*Projects – Planning, analysis, selection, implementation and review*",Tata McGraw-Hill, New Delhi, 2010.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		3		2			2	1					2	1
CO2			2				2				3				
CO3		1	2		1				1			1		1	1
CO4	3		2		2	2				2		2			

ENTREPRENEURSHIP DEVELOPMENT

IV Year B.Tech. (Mech) Seventh Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To develop and strengthen the basic entrepreneurship knowledge for students
2. To impart basic entrepreneurial skills and understanding to run a business efficientlyand effectively.
3. To develop skills for registering a company and gain the knowledge on sources offunds and Establishing distribution network
4. To make the student aware MSMEs, Role and schemes of government in establishingenterprises in general and women entrepreneurship, social entrepreneurship in specific.

Course Outcomes:

Upon completion of the course, students will be able to

1. Understand the meaning of entrepreneur and able to visualize the benefits of being anentrepreneur
2. Unearth the entrepreneurial qualities hidden in them and apply them to theentrepreneurial activities
3. Understand the procedure for registering a company and gain the knowledge onsources of funds and Establishing distribution network
4. Realize the importance of MSMEs and the government support, formation and thecharacteristics of women entrepreneurship and social entrepreneurship

UNIT 1

ENTREPRENEURSHIP

Evolution of the concept of entrepreneurship, Meaning of Entrepreneur, functions of an entrepreneur, types of entrepreneurs, and stages in entrepreneurial process. (2)

Role of entrepreneurs in economic development, possible value creation by an enterprise - direct and indirect employment, government revenue, value to consumers in terms of quality products and services, export and import substitution. (6)

Challenges and opportunities of entrepreneurship – risk, return, professional fulfilment, spinoffs from academia – the Indian and global scenario, Factors Affecting Entrepreneurial growth. (6)

UNIT-II

FORMULATION OF BUSINESS UNIT:

Building and Leading Effective Team. Selecting a balanced team and related issues. important Tasks for Starting a New Business. (4)

Market Research, identification of business opportunities, Identifying the products and/ or services, deciding on geographical location Market Feasibility study; technical, financial, and social feasibility study. (8)

Enterprise in project mode; identification, selection, project report need and significance; Project Appraisal Methods, (2)

UNIT-III

STARTING A BUSINESS UNIT: Form of business organization, naming and registering/ incorporating a company, (4)

Raising funds, Sources of Fund, Raising loan fund, seed fund, equity capital, sources of grants/subsidies and margin money, loan restructuring and other concessions available to financially weak business units.Banking sources; Non-banking Institutions and Agencies. Establishing distribution network, branding and acquiring strategic assets, product pricing Critical Success and Failure Factors. Legal Issues of Business, Corporate Governance and Business Ethics. (4)

UNIT-IV

MICRO, SMALL AND MEDIUM ENTERPRISES (MSMEs): Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes. (4)

ENTREPRENEURSHIP DEVELOPMENT AND GOVERNMENT: Role of CentralGovernment and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available; Central/State agencies in the Entrepreneurship development. (6)

WOMEN ENTREPRENEURSHIP:

Concept of women entrepreneurship-Reasons for growth of woman entrepreneurship-Problems faced by them and remedial measures

SOCIAL ENTREPRENEURSHIP: Definition, types, examples, issues.

TEXT BOOKS

1. Khanka. S.S., ‐Entrepreneurial Development‖ Chand& Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, ‐Entrepreneurship-Theory, Process and Practice**‖**, 9th Edition, Cengage Learning, 2014.
3. Raj Shankar, ‐Entrepreneurship: Theory and Practice**‖**,Vijay Nicole imprints Ltd in collaboration with Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2012.

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**

CO1		2	1	2	1	2	2	2	1	2	1	2	1		1
CO2	1	2	2	2	1	1	2	2	2	3	3	3	2	2	2
CO3		1						2	1	3	2	2	1		
CO4		1						2	1	3	2	2	1		

CO-PO MAPPING

NON-CONVENTIONAL ENERGY SOURCES

IV Year B.Tech. (Mech) Seventh Semester

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

CO 1: To enable students to identify different sources of non conventional energy and innovative Technologiesin harnessing energy from these sources.
CO 2: Understand the energy conversion from wind energy, geothermal energy, Biomass, biogas, fuel cells. CO 3: Understand the advantages and limitations of different non conventional energy sources and identify awide variety of applications for non conventional energy.

Course Outcomes: At the end of the course,
the student will be able toCO-1: Understand
different methods of exploiting solar energy.
CO-2: Understand the principles and energy conversion from
wind and geo thermal sourcesCO-3: Gain knowledge in exploring
the energy from ocean, tidal and bio-mass
CO-4: understand the techniques in power generation using Fuel cells, bio gas and MHD

UNIT-I

Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits
Solar Energy: Extra terrestrial solar radiation - terrestrial solar radiation –solar radiations on earth-measurement of solar radiations-solar constant-solar collectors-flat plate collectors-concentrating collectors-solar thermal conversion-solar thermal central receiver systems - photovoltaic energy conversion - solar cells-applications of solar energy

UNIT-II

Wind energy: Availability of wind energy in India, site selection-Components of wind energy conversion systems-Classification of wind energy conversion systems-vertical axis and horizontal axis wind turbines- Performance characteristics-Betz criteria coefficient-applications of WECS-environmental aspects
Geo thermal Energy: Structure of earth's interior-geothermal sites-geothermal resources-Site selection for geothermal power plants-Principle of working-various types of geothermal power plants- applications

UNIT-III

Ocean thermal energy conversion (OTEC): Principle of ocean thermal energy conversion-Open cycle andclosed cycle OTEC plants-Merits and demerits
Tidal Power: Tides and waves as sources of energy-fundamentals and use of tidal energy-limitations of tidalenergy conversion system
Bio mass: Availability of biomass and its conversion techniques-bio mass gasification-

bio mass resourcedevelopment in India

UNIT-IV

Bio Gas: Bio gas production, aerobic and anaerobic bio conversion process-
Properties of bio gas-classificationof biogas plants-advantages and disadvantages-
bio gas applications
Fuel Cells: Classification, Principle of working of various types of fuel cells, merits and demerits, future potentialof fuel cells.
Magneto-Hydrodynamics (MHD): Principle of working of MHD Power plant, Classification, advantages anddisadvantages.

Energy storage methods- **Batteries,** super capacitors, **compressed air,** superconducting magnet energy storage, Regenerative fuel cell storage.

TEXT BOOK:

3. H.P. Garg& Jai Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill,New Delhi
4. Non-Conventional Energy Sources by G.D.Rai, Khanna Publisher
5. B H Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw Hill Education Pvt Ltd, 2011

REFERENCE BOOKS:

4. Power plant technology by EL-Wakil, McGraw-Hill.
5. Renewable Energy Sources by John Twidell& Toney Weir: E&F.N. Spon

CO-PO MAPPING

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1		2		2			2	1					2	1
CO2			2				2								
CO3		1			1				1			1		1	1
CO4	3		2		2	2				2		2			2

Lectures	3	Tutorial	0	Practical	0	Credits	3
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. The course aims at providing the basic concepts of product design, product features

2 Its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.

3 To understand the design for manufacturing and product development

4 To understand the embodiment design and new product development

Course Outcomes:

After completion of the course, the student would be able to

1 The student will be able to design some products for the given set of applications;

2 The knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.

3 Analyze the set of potential innovation triggers and strategically select those opportunities that fit with the organizational resources and strategies.

2 Analyze the new product development

UNIT-I

Introduction - Concept Generation and Selection

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits. (14)

UNIT-II

Product Architecture: Implications – Product change – variety – component standardization – product performance -manufacturability – product development management – establishing the architecture – creation -clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications. (14)

UNIT-III

Design for Manufacturing and Product Development: Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs -Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes - Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution.

(14)

UNIT-IV

Embodiment Design: Introduction to embodiment design – product architecture – types of modular architecture –steps in developing product architecture Industrial design – human factors design –user friendly design (6)

New Product Development: Supporting techniques for new product development processes such as quality function deployment and quality engineering and Taguchi Method. (8)

TEXT BOOKS

1. Karl T. Ulrich, Steven D. Eppinger, Product Design and Development, Sixth Edition, McGraw-Hill, 2015.
2. A.K. Chitale, R.C. Gupta, Product Design and Manufacturing, Sixth Edition, Prentice – Hall of India, 2013.

REFERENCE BOOKS

3 Kemnneth Crow, Concurrent Engg./Integrated Product Development, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
4 Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
5 Staurt Pugh, Tool Design -Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, New york, NY.
6 Robert G. Cooper, Winning at New Products: Creating Value Through Innovation, Hachette Book Group, Newyork, 2017.
7 John Starc, Product Lifecycle Management (Decision Engineering), Springer Publications, 2015.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2		1		1	2		3	2	1		2	1	2	3
CO2	3		1		3	1	1	2		1		2		1	2
CO3	1	1	2		2	3	1		2	3	1		2		3
CO4	1		2	1	3	2	3	2		1	2		3	2	

HONOR COURSES

DEPARTMENT OF MECHANICAL ENGINEERING
HONOUR COURSES OFFERED BY MECHANICAL ENGINEERING:
List of Honors courses

SUBJECT CODE	SUBJECT	L	T	P	Credits
20ME-HC 1	Advanced Strength of Materials	4	0	0	4
20ME-HC 2	Non-Destructive Evaluation	4	0	0	4
20ME-HC 3	Mechanical vibrations	4	0	0	4
20ME-HC 4	Nano Technology	4	0	0	4

20ME-HC 5	Finite Element Analysis	4	0	0	4
20ME-HC 6	Advanced Manufacturing Processes	4	0	0	4
20ME-HC 7	Farm machinery and equipment	4	0	0	4
20ME-HC 8	Industrial robotics	4	0	0	4
20ME-HC 9	Energy Conservation and Management	4	0	0	4
20ME-HC 10	Computational Fluid Dynamics	4	0	0	4
20ME-HC 11	Composite Materials	4	0	0	4
20ME-HC 12	Computer Integrated Manufacturing	4	0	0	4
20ME-HC 13	Product Design and Development	4	0	0	4
20ME-HC 14	Entrepreneurship Development	4	0	0	4
20ME-HC 15	Supply chain Management	4	0	0	4
20ME-HC 16	Total Quality Management	4	0	0	4

*For obtaining Honors/Minors, the students has to complete two MOOC's (NPTEL/Swayam) Programs of eight weeks each, in-addition to the four courses scheduled in the course structure, not exceeding two courses (One for Honor and One for Minor) in a semester.

ADVANCED STRENGTH OF MATERIALS
20ME-HC 1

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

To make the students to understand and analyze various types of beams, thick pressure vessels, rotating discs under various conditions including curved members, and to have the knowledge about strain energy of structural members under variety of loading conditions.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Determine the stresses caused due to temperature effects and analyze the indeterminate beams
CO2: Determine the shear stresses in beams and analyze the beams under unsymmetrical loading
CO3: Describe the analysis of curved members and thick cylinders
CO4: Understand the centrifugal stresses caused in rotating discs and the fundamental concept of strain energy

UNIT-I
TEMPERATURE STRESSES AND DYNAMIC LOADING: Thermal effects, misfits and pre strains. Dynamic loading, suddenly applied load, inelastic effects and causes of failure. (6)

STATICALLY INDETERMINATE BEAMS: Introduction, analysis by the differential equations of the deflection curve, moment area method (6)

UNIT-II
SHEAR STRESSES IN BEAMS: Shear stresses in Rectangular beams, Shear stresses the webs of beams with flanges, Shear stresses circular beams (6)
UNSYMMETRIC BENDING: Introduction, Doubly symmetric beams with skew loads, pure bending of unsymmetric beams, generalized theory of pure bending of beams under lateral loads (6)

UNIT-III
BENDING OF CURVED MEMBERS: Introduction, Winkler-bach formula to determine the stresses in the curved beams of various cross sections such as rectangular, triangular, circular and trapezoidal (6)
THICK PRESSURE VESSELS: Thick cylinders, lame's theory, radial deflection, compoundcylinder. (6)
UNIT-IV
CENTRIFUGAL STRESSES: Introduction, rotating ring, rotating disc (solid and hollow), disc of uniform strength (7)

STRAIN ENERGY: Expressions for strain energy under various loads (axial, pure shear, bending and torsion) (5)

TEXT BOOKS

1. Mechanics of Materials, 6 E by James M Gery (Thomson Learning Inc.)
2. Strength of Materials by Dr. Sadhu Singh (Khanna Publishers)

REFERENCE BOOKS

1. Mechanics of materials 6 E by Beer, Johnston, Dewolf, Mazurek (Mc Graw Hill Education)
2. Strength of materials, 3E by S.S.Rattan (Mc Graw Hill Education)

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2										2	2	1
CO2	2	2	2										2	2	1
CO3	2	1	1										2	2	1
CO4	2	2	2										2	1	2

NON-DESTRUCTIVE EVALUATION
20ME-HC 2

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

To make the students to understand and apply the fundamental concepts of Non-destructive evaluation of engineering materials.
To enable selection of suitable NDT methods
To identify advantages and limitations of various Non-Destructive Testing methods
To make aware the developments and future trends in Non-Destructive Testing methods

Course Outcomes:
Upon successful completion of the course, the student will be able to

CO1: Understand the fundamental concepts of Non-destructive Testing Methods
CO2: Illustrate the Magneto particle Inspection on various materials
CO3: Describe the Concepts of Ultrasonic Testing and use of industrial needs
CO4: Define the basic concepts of Radiography testing and Eddy current testing

UNIT-I
INTRODUCTION TO NON DESTRUCTIVE TESTING AND SURFACE TESTING METHODS:
Introduction, NDT versus Destructive Testings, over view of non-destructive testing methods for detection of manufacturing defects. Relative merits and limitations, economics aspects of NDT.
VISUAL INSPECTION -tools, applications and limitations – Fundamentals of visual testing: vision, lighting, material attributes, environmental factors. Visual perception, direct and indirect methods mirrors, magnifiers, boroscopes, fibroscopes, closed circuit television, light sources. Special lighting, a systems, computer enhanced system. (8)
LIQUID PENETRANT INSPECTION Principles, properties required for a good penetrants and developers - Types of penetrants and developers and advantages and limitations of various methods of LPI - LPI technique/ test procedure. Interpretation and evaluation of penetrant test indications, false indication and safety precaution required in LPI, applications, advantages and limitations. (7)

UNIT-II
MAGNETIC PARTICLE INSPECTION (MPI): Principles of MPI, basic physics of magnetism, permeability, flux density, cohesive force, magnetizing force, retentively, residual magnetism. Methods of magnetization, magnetization techniques such as head shot technique, cold shot technique, central conductor testing, magnetization using products using yokes. Direct and indirect method of magnetization, continuous testing of MPI, residual technique of MPI, system sensitivity, checking devices in MPI. Interpretation of MPI, indications, advantage and limitation of MPI. (15)

UNIT-III

ULTRASONIC TESTING (UT): principle, types of waves, frequency, velocity, wavelength, reflection, divergence, attenuation, mode conversion in ultrasonic UT testing methods. Contact testing and immersion testing, normal beam and straight beam testing, angle beam testing, dual crystal probe, ultrasonic testing techniques, instruments used UT, accessories such as transducers, types, frequencies, and sizes commonly used. Applications, advantages, limitations, A, B and C scan - Time of Flight Diffraction (TOFD). (15)

UNIT-IV

RADIOGRAPHY TESTING (RT): Principle, electromagnetic radiation sources: X-ray source, production of X-rays, high energy X-ray source, gamma ray source - Properties of X-rays and gamma rays. Inspection techniques like SWSI, DWSI. Safety aspects required in radiography applications, advantages and limitations of RT. (8)

EDDY CURRENT TESTING (ECT): Principle, physics aspects of ECT like conductivity, permeability, resistivity, inductance, inductive reactance, impedance.

Equipments and accessories, various application of ECT such as conductivity measurement, hardness measurement, defect detection, coating thickness measurement, advantages and limitations of eddy current testing. (7)

TEXT BOOKS

4. B. Raj, T. Jayakumar and M. Thavasimuthu, Practical Non Destructive Testing, Alpha Science International Limited, 3rd edition (2002).
5. J. Prasad and C. G. K. Nair, Non-Destructive Test and Evaluation of Materials, Tata McGraw-Hill Education, 2nd edition (2011).
6. Non-Destructive Examination and Quality Control, ASM International, Vol.17, 9th edition (1989)

REFERENCE BOOKS

4. C. Hellier, Handbook of Non Destructive Evaluation, McGraw-Hill Professional, 1st edition (2001).
5. N. A. Tracy, P. O. Moore, Non-Destructive Testing Handbook: Liquid Penetrant Testing, Vol. 2, American Society for Non-destructive Testing, 3rd edition (1999).
6. J. Thomas Schmidt, K. Skeie and P. Maclntire, ASNT Non Destructive Testing Handbook: Magnetic Particle Testing, American Society for Non-destructive Testing, American Society for Metals, 2nd edition (1989).

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	1	1										1	2	2
CO2	2	2	1	1			1						1	2	2
CO3	2	1	1				1						1	2	2
CO4	2	2	1				1						1	2	2

MECHANICAL VIBRATIONS
20ME-HC 3

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

The objective of this course is to learn how to treat the vibration phenomena by transforming the physical model into a mathematical model and solve it by using the appropriate mathematical operations to find the response and analyze this response and bring it back to its physical concept.

Course Outcomes:

After the completion of the course the students will be able to

CO1: Understand the basics of vibration and analyze free & forced vibrations of single DOF systems.

CO2: Convert a multi DOF physical system into a mathematical method and calculate the parameters of vibrations.

CO3: Analyze continuous systems for their vibration parameters.

CO4: Use classical methods to analyze multi DOF systems and find their natural frequencies.

UNIT-I

Oscillatory Motion: - Harmonic motion, Periodic motion, Vibration terminology (3)

Free Vibration: - Vibration model, Equations of motion: Natural frequency, Energy method, Rayleigh method: Effective mass, Principal of virtual work, Viscously damped free vibration, logarithmic decrement. (4)

Harmonically Excited Vibration: - Forced harmonic vibration, Rotating unbalance, Support motion, Vibration isolation. (4)

UNIT-II

Systems with Two or More Degrees of Freedom: - The normal mode analysis, Initial conditions, Coordinate coupling, Forced harmonic vibration, Finite difference method for systems of equations, Vibration absorber, Centrifugal pendulum vibration absorber, Vibration damper

(11)

UNIT-III

Properties of Vibrating Systems: - Flexibility influence coefficients, Reciprocity theorem, Stiffness influence coefficients, Orthogonality of eigenvectors, Decoupling forced vibration equations. (6)

Vibration of Continuous Systems: - Vibrating string, longitudinal vibration of rods, torsional vibration of rods, vibration of suspension bridges, Euler equation for beams, systems with repeated identical sections

(6)

UNIT-IV

Classical Methods: - Rayleigh method, Dunkerley's equation, Rayleigh-Ritz method, Holzer method. (11)

TEXT BOOKS

1. Theory of Vibration with Applications – Willam T Thomson & Marie Dillon Dahleh, Pearson Education, 5th Edition.

REFERENCE BOOKS

3. Mechanical Vibration by S. S. Rao, Pearson, 6th Edition.
4. Mechanical Vibrations by G. K. Groover, Nem Chand & Bros., Roorkee, 8th Edition.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2		1	1							1	3	2	
CO2	2	2		2	1								3	2	
CO3	3	3		2	2								3	3	
CO4	3	3		3	3								3	3	

Nanotechnology
20ME-HC 4

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

5. To familiarize with the fundamentals of nanotechnology, evolution of the nano-science and potential applications.
6. To explore the available nanomaterials based on carbon, metals and metal oxides developed for industrial applications.
7. To familiarize the existing synthesizing processes to develop various nano-surfaces and nanomaterials.
8. To acquire sound knowledge on different characterization methods developed for studying nanomaterials.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO 5 Understand the importance of nanotechnology for emerging engineering applications.

CO 6 Differentiate the nanomaterials based on the composition and physical properties.

CO 7 Select appropriate process to produce nanomaterials in the form of powders or bulk structures.

CO 8 Investigate the fundamental properties of nanomaterials by using appropriate characterization technique.

UNIT-I :

Introduction: History of nanoscience, definition of nanometer, nanomaterials, nanotechnology. Why nanomaterials? Properties of materials influenced by nanosize: mechanical properties, electrical properties, dielectric properties, thermal properties, magnetic properties, opto-electronic properties. Levels of structures, effect of size reduction on properties. (15)

UNIT-II:

Different classes of nanomaterials: classification based on dimensionality-quantum dots, wells and wires, Carbon-based nanomaterials - bucky balls, carbon nanotubes, graphene, Metal based nanomaterials - nanogold, nanosilver and metal oxides, nanocomposites, nanopolymers, nanoglasses, nanoceramics, biological nanomaterials. (15)

UNIT-III:

Synthesis and fabrication: Synthesis of bulk polycrystalline nanomaterials, growth of single crystals. Synthesis techniques for preparation of nanoparticle – bottom up approach – sol gel synthesis, hydrothermal growth, thin film growth, PVD and CVD; top down approach – ball milling, micro fabrication, lithography, mechanical processing-severe plastic deformation techniques.

(15)

UNIT-IV:

Charecterization of nanomaterials: X-Ray diffraction method, scanning electron microscopy (SEM), transmission electron microscopy (TEM), atomic force microscopy, particle size analysis. Applications of nanotechnology in medicine, surface science, energy and environment sciences. Challenges and limitations in processing, handling, toxicity and issues with safety measures. (15)

TEXT BOOKS

3) M.S Ramachandra Rao, Tatsuo Okada, Nano science and nano technology, Wiley publishers, 2013
4) B.S. Murty, P. Shankar, B. Raj, B.B. Rath, J. Murday, Textbook of Nanoscience and Nanotechnology Springer publishers, 2013

REFERENCE BOOKS

5) Charles P. Poole, Jr., Frank J.Owens, Introduction to Nano Technology Wiley publishers. USA, 2007
6) Jermy J Ramsden, Nanotechnology, Elsevier publishers, USA, 2016
7) M.A Shah, K.A Shah, Nanotechnology the Science of Small Wiley Publishers, 2015

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2		1	1	1	1	1	1	1		1	2	1	2
CO2	2	1	1	2	3	2	2	1	2	2		2	2	2	1
CO3	3	2	2			3	1	2	1	3		1	2	1	3
CO4	2	1	2	2	2	1		1	2	2	1	2	2	1	2

FINITE ELEMENT ANALYSIS
20ME-HC 5

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:
To provide concepts on Finite Element Analysis and to help the students to use this method and to solve the problems in structural analysis and in heat transfer

Course Outcomes:
CO1: Students able to derive element matrix equation by different methods by applying basic laws in mechanics and integration by parts
CO2: Apply direct stiffness, Galerkin method to solve engineering problems and outline the requirements for convergence
CO3: Analyse the linear 1D problems like bars and trusses; 2D structural problems using CST elements
CO4: Solve the 1-Dimentional dimensional heat conduction problems using triangular elements

UNIT-I
Fundamental concepts: Introduction, historical background, Analysis of 3-D stresses & strains, stress-strain relations, stress cubic, principal stress calculations, temperature effects, potential energy and equilibrium.
(12)

UNIT-II
Basic concepts of FEA and One-Dimensional problems: Fundamental concepts, Finite Element Modelling, Coordinates and Shape functions, The Potential Energy Approach, The Galerkin Approach, Assembly of the Global Stiffness Matrix and Load Vector, Properties of Global Stiffness Matrix, The Finite Element equations; Treatment of boundary conditions, Examples of Axially Loaded Members.
(8)

Truss analysis: initial conditions for the truss system, transformation matrix, analysis of truss using FEM for three truss members. (4)

UNIT-III
Two Dimensional Problems: Introduction, Plane Stress and Plane Strain, Finite Element Modelling, Constant Strain Triangle (CST); Iso-parametric representation, Potential Energy Approach, Element Stiffness, Force terms, Galerkin Approach, Stress calculation, Problem modelling and boundary conditions, Examples of plane Stress and plane Strain problems with three degrees of freedom using CST Element. (12)

UNIT-IV
Scalar Field Problems: Introduction, study-state heat transfer, one-dimensional heat conduction, governing equation, boundary conditions, the one-dimensional element, functional approach for heat conduction. (12)

TEXT BOOKS
3. Introduction to Finite Elements in Engineering by Chandrupatla&Belegundu, 3rd edition, PHI.

4. Experimental Stress analysis by P. Seshu, PHI, 2012.

REFERENCE BOOKS

5. Finite Element Analysis by C.S.KrishnaMoorthy, McGraw Hill Publications, 2017.
6. Finite Element Analysis by L.J.Segerlind, Wiley Publications, 2nd edition, 1984.
7. Cook, Robert Davis et al, "Concepts and Applications of Finite Element Analysis" , Wiley, John & Sons,1999
8. George R Buchanan, "Schaum's Outline of Finite Element Analysis", McGraw Hill Company, 1994.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1		1								2	1	2
CO2	3		2		2								2	2	2
CO3	3	2	2		2								2	2	2
CO4	3	2	2		1								2	1	2

ADVANCED MANUFACTURING PROCESSES
20ME-HC 6

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

5. To describe and demonstrate different unconventional machining processes
6. To explore the recently developed welding and adhesive bonding processes and their applications
7. To familiarize with the basic concepts of micromachining and different processes with potential applications.
8. To describe the principles and applications of different additive manufacturing processes

Course Outcomes:

Upon successful completion of this course, the student will be able to

1. Understand and learn different unconventional machining processes and choose appropriate process to produce a given component
2. Distinguish the advanced welding processes suitable for various material systems.
3. Differentiate the basic principles of machining and micromachining and select a suitable micromachining process and develop a miniature micromahchine tool.
4. Understand the basic mechanisms of additive manufacturing processes and their potential applications in different engineering fields.

UNIT-I

UNCONVENTIONAL MACHINING PROCESSES: Introduction, principles, operation, equipment and applications of abrasive jet machining (AJM), ultrasonic machining (USM), water jet machining (WJM), electric discharge machining (EDM), chemical machining and electrochemical machining (CHM and ECM), electron beam machining (EBM), laser beam machining (LBM) and plasma arc machining (PAM) (15)

UNIT-II

ADVANCED WELDING: Principles, mechanisms and applications ofsolid state welding,friction welding, friction stir welding, explosion welding, ultrasonic welding, underwater welding, diffusion welding, cold pressure welding and hot pressure welding. (12)

ADHESIVE BONDING: Introduction, classification of adhesives, joint design, methods, applications. (3)

UNIT-III

MICROMACHINING: Introduction, microstructure and material properties, theory of micromachining, chip formation, surface roughness, cutting fluids, principles and applications of micro turning, micro milling, micro drilling, precision grinding, and laser beam micromachining. Fabrication of micro cutting tools and development of miniature machine tools. (15)

UNIT-IV

ADDITIVE MANUFACTURING: Introduction, CAD in additive manufacturing, liquid based and solid based processes, laser technology, stereo lithography, fused deposition, selective laser sintering, 3D printing technologies, laser engineered net shaping (LENS), principles and applications. (15)

TEXT BOOKS

3. A Text book of Production Engineering by P.C.Sharma, S.Chand& Co.
4. Manufacturing Science by Ghosh&Mallik,
5. Sami Franssila, "Introduction To Micro Fabrication", John Wiley And Sons Ltd., UK, 2004.
6. Chua C.K., Leong K.F., And Lim C.S., "Rapid Prototyping: Principles And Applications", Third Edition, World Scientific Publishers, 2010.

REFERENCE BOOKS

5. Kalpakjian, "Manufacturing engineering & technology", Pearson Education / PHI
6. Mikell P. Groover, "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems", 2010, John Wiley, NY.
7. Messler R. W., "Principles of Welding Processes: Physics, Chemistry, and Metallurgy", 1999, John Wiley, NY
8. Madore J, "Fundamental Of Micro Fabrication", CRC Press, 2002. USA
9. Liou L.W. and Liou F.W., "Rapid Prototyping And Engineering Applications: A Tool Box for Prototype Development", CRC Press, 2007. USA

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	1			2	1	1			2		2	2	1	3
CO2	2	1		1	2	1			1	2	1	2	2	1	2
CO3	2	1	1	1	2					1	1	2	2		1
CO4	2	1	1	2	3	1			1	2	1	3	2		3

FARM MACHINARY AND EQUIPMENT
20ME-HC 7

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

UNIT I

INTRODUCTION

Objectives of farm mechanization. Classification of farm machines. Materials of construction & heat treatment. Principles of operation and selection of machines used for production of crops. Field capacities & economics.

TILLAGE: primary and secondary tillage equipment. Forces acting on tillage tools. Field operation patterns. Draft measurement of tillage equipment

(15)

UNIT II

EARTH MOVING EQUIPMENT - their construction & working principles viz Bulldozer, Trencher, Excavators

SEEDING METHODS - Different types of seed metering mechanism, different types of furrow openers. Calibration of Seed drills. Adjustment of Seed Drills -Objectives and uses of plant protection equipment.

TRANSPLANTING METHODS - different types of Transplanting machinery and their working principle, adjustments in Transplanting equipment. (15)

UNIT III

FERTILIZER APPLICATION EQUIPMENT - Weed control and Plant protection equipment , sprayers and dusters, their calibration, selection, constructional features of different components and adjustments.

Principles & types of cutting mechanisms. Construction & adjustments of shear type cutting mechanisms. (15)

UNIT IV

CROP HARVESTING MACHINERY - Introduction to Crop Harvesting Methods and their Mechanization

MOWER - Types, Working Principle and Constructional Details, Functional Parameters of Mower Cutter-bar

REAPERS AND WINDROWERS - Types, Working Principle and Constructional Details, Reaper-Binder Adjustments and Performance

CASE STUDIES OF HARVESTING EQIPMENT

Potato Digger- working principle and constructional details ; Groundnut Harvester- working principle and constructional details ; Sugarcane Harvester- working principle and constructional details (15)

TEXT Books

1. Principle of Farm Machinery (Latest edition) by R. A. Kepner, Roy Bainer and E. L. Barger. C & S Publishers and Distributors, New Delhi, India.
2. Farm Machinery and Equipment, 6th edition by H. P. Smith and L. H. Wilkey. Tata McGraw Hill Publishing Co. Ltd., New Delhi, India.
3. Principle of Agricultural Engineering, Vol. I (Latest Edition) by A. M. Michael and T. P. Ojha. Jain Brothers, New Delhi, India.

REF BOOKS

1. Testing and Evaluation of Agricultural Machines by M. L. Mehta, S. R. Verma, S. K. Mishra and V. K. Sharma.
2. Agricultural Engineering (Through Worked Examples) by Radhey Lal and A. C. Datta. Saroj Publishers, Allahabad

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1															
CO2															
CO3															
CO4															

INDUSTRIAL ROBOTICS
20ME-HC 8

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

1. To provide the student with knowledge of classification of robots and application of robots
2. To develop the student's knowledge in various end effectors of robots and programming of robots including various programming languages.
3. To provide the student with sufficient knowledge of various sensory devices and their working principles and applications in robots.
4. To develop student's skills in performing spatial transformations associated with rigid body motions and to perform kinematics analysis of robot systems

Course Outcomes:

After completion of the course the student must be able to

1. Acquire knowledge on basic structure & development of Industrial robots
2. Understand various types of end effectors & methods of programming a robot
3. Plan and execute sensors used in robots
4. Solve transformation and kinematic problems of robots

UNIT-I

Introduction to Robotics: major components of a robot, robotic like devices, classification of robots– Classification by coordinate system and by control method, Specifications of robots,fixed versus flexible automation, economic analysis, overview of robot applications. (15)

UNIT-II

Robot end Effectors: Introduction, end effectors, interfacing, types of end effectors, grippers and tools, considerations in the selection and design of remote centered devices. Various methods of programming robots: Robot programing languages
(15)

UNIT-III

Robotic sensory devices: Sensor Characteristics, Position sensors, Velocity sensors, Acceleration sensors, Force and pressure sensors, Torque sensors, micro switches, light and Infrared sensors, Touch and Tactile sensors, Proximity sensors & Range finders. (15)

UNIT-IV

Transformations and Kinematics: Objectives, homogenous coordinates, basic transformation operations, forward solution – Denavit Hartenberg procedure. Simple problems involving planar manipulators, inverse or backward solution – problems involved, Introduction to Trajectory Planning, the manipulator jacobian.
(15)

TEXT BOOKS

1. Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, "Industrial Robotics- Technology, Programming and Applications" ,2 edition, McGraw Hill Education (India) Private Limited, New Delhi 2013

2. Saeed B. Niku, “Introduction to Robotics- Analysis, Systems, Applications”, 1st edition, Prentice-Hall of India Private Limited, New Delhi 2007

REFERENCE BOOKS

1. R. K. Mittal, I. J. Nagarth, “Robotics and Control” Tata McGraw Hill Publishing Company Limited, 2005.
2. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, ”ROBOTICS Control, Sensing, Vision and Intelligence” 1987, McGraw-Hill Book Company,
3. S. R. Deb, “Robotics Technology and Flexible Automation” 2006, Tata McGraw-Hill Publishing Company Limited.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2													
CO2	2	1	1												
CO3	3	1	3												
CO4	2	3	3												

ENERGY CONSERVATION AND MANAGEMENT
20ME-HC 9

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course objectives

To make the student to understand and describe concepts of energy conservation and management.

Course outcomes

Student should be able to

1. understand the basic knowledge of different terms & principles of energy conservation and evaluate thermal performance.
2. Evaluate the energy saving & conservation in different mechanical utilities.
3. prepare energy audit report for different energy conservation instances and carry out the cost- benefit analysis of various investment alternatives for meeting the energy needs of the organization.
4. understand energy monitoring and targeting

UNIT-I

Energy Scenario: Classification of Energy, Indian energy scenario, Sectorial energy consumption (domestic, industrial and other sectors), energy needs of growing economy, energy conservation and its importance, Energy Conservation Act 2001 and related policies (5)

Evaluation of thermal performance: calculation of heat loss - heat gain, estimation of annual heating & cooling loads, factors that influence thermal performance, analysis of existing buildings, setting up an energy management programme and use management - electricity saving techniques (10)

UNIT-II

Energy Efficiency in Thermal Utilities and systems: Energy efficiency in thermal utilities like boilers, furnaces, pumps and fans , compressors, cogeneration (steam and gas turbines), heat exchangers ,lighting system, refrigeration system. (10)

Heat Recovery and Co-generation: Heat recovery from ventilation, air co-generation of heat and electricity, heat recovery and bottoming cycles (5)

UNIT-III

Energy Management & Audit: Definition, energy audit, need, types of energy audit. Energy management (audit) approach-understanding energy costs, Bench marking, energy performance, matching energy use to requirement, energy audit instruments and metering. (7)

Financial Management: Investment-need, appraisal and criteria, financial analysis techniques simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of Energy Service Companies (ESCOs) (8)

UNIT-IV

Energy Monitoring and Targeting: Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques - energy consumption, production, cumulative sum of differences (CUSUM), Energy Management Information Systems (EMIS) (15)

TEXT BOOKS

1. Energy Manager Training Manual (4 Volumes) Available At www.energymanagertraining.com, A Website Administered By Bureau Of Energy Efficiency (BEE), A Statutory Body Under Ministry Of Power, Government Of India, 2004.

2. Amlan Chakrabarti, Energy Engineering and Management, Prentice hall India 2011.

3. CB Smith, Energy Management Principles , Pergamon Press, New York

4.Witte. L.C., P.S. Schmidt, D.R. Brown, "Industrial Energy Management and Utilisation" Hemisphere Publ, Washington, 1988.

REFERENCE BOOKS

1.Callaghn, P.W. "Design And Management For Energy Conservation", Pergamon Press, Oxford, 1981.
2. De, B. K., "Energy Management audit & Conservation", 2nd Edition, Vrinda Publication, 2010.
3.Murphy. W.R. And G. Mc KAY, "Energy Management", Butterworths, London 1987.
4.Turner, W. C., Doty, S. and Truner, W. C., "Energy Management Hand book", 7thedition, Fairmont Press, 2009.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1				2	2	2						2		1
CO2	2	2	2		2	2	2						2	2	2
CO3	2					2	2						2		
CO4	1	2			2	2	2						2		

COMPUTATIONAL FLUID DYNAMICS
20ME-HC 10

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:
To make the learners to

1. Understand the scope, principles, norms, accountabilities and bounds of contemporary engineering practice in the fluid flow.
2. Describe the finite difference method and the finite element method with emphasis on fluid dynamics on various computational problems in fluid dynamics such as boundary conditions and meshing.
3. Provide the essential numerical background for solving the partial differential equations governing the fluid flow.
4. Develop student's skills by using a commercial software package.

Course Outcomes:
After successful completion of this course, student will be able to:

1. Familiar with the differential equations for flow phenomena and numerical methods for their solution.
2. Use and develop flow simulation software for the most important classes of flows in engineering and science.
3. Analyze the different mathematical models and computational methods for flow simulations.
4. Define the relevant engineering flow problems and analyzes the CFD results by CFD software. Compare with available data, and discuss the findings.

UNIT-I
INTRODUCTION: Historical Background of CFD, Applications, Boundary conditions and steps in CFD. (5)
GOVERNING EQUATIONS: Continuity, Momentum and Energy equations in 3 Dimensions, Navier-Stokes equations, Single Generic Integral form equations for Continuity, Momentum and Energy. (10)

UNIT-II
DISCRETIZATION: Basic aspects of discretization, Techniques used--Finite Difference, Finite Volume and Finite Element, comparison of methods, difference equations, Explicit and
Implicit approaches. (15)

UNIT-III
GRID GENERATION AND TRANSFORMATION: Generation of grid, Transformation of non-uniform grids, General transformation of equations, form of governing equations suitable

for CFD, Compressed grids, Boundary filled coordinate systems—Elliptic grid generation, Adaptive grids, Modern developments in grid generation. (15)

UNIT-IV

CFD TECHNIQUES: Introduction, CRANK-NICHOLSON technique, Relaxation technique, ADI technique, suitability for different conditions. Errors due to approximation and their analysis-Consistency, Convergence, Stability Analysis. (15)

TEXT BOOKS

1. Computational Fluid Mechanics - Anderson, D.C., J.C, Tannehil, and R.H. Fletcher, Hemisphere Publishing Corporation, New York.
2. Computational Fluid Dynamics – T.J.Chung, Cambridge University Press 2002

REFERENCE BOOKS

1. Computational Methods for Fluid Dynamics – Ferziger, J.H. and M.Peric, Springer, 3rd Edition, 2002.
2. An Introduction to Computational Fluid Dynamics – The Finite Volume Method – Versteeg, H.K. and W.Malalasekera, Second Edition, 2007.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3		3		2			3			1		3	2	1
CO2	3	3	3					3			2		1	2	3
CO3	3	3	3					2			2		2	2	1
CO4	3	2	3					2					3	2	2

COMPOSITE MATERIALS
20ME-HC 11

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

1. To familiarize with the basic meaning of composite materials and their properties with potential industrial applications.
2. To formulate and analyze problems related to the mechanical behavior of the composites subjected to different external influencing factors.
3. To familiarize the expressions and methods in evaluating the mechanical performance of composite laminates.
4. To acquire sound knowledge on different manufacturing processes of composites.

Course Outcomes:

Upon successful completion of the course, the student will be able to

1. Understand and differentiate the mechanical behavior of laminated composites compared with isotropic materials.
2. Apply the basic equations to analyze the mechanics of the composites at micro and macro level.
3. Determine stresses and strains developed in composites materials
4. Adopt and develop appropriate manufacturing processes to produce composite materials.

UNIT-I

INTRODUCTION: Classification and characteristics of composite materials – polymer matrix composites, ceramic matrix composites, metal matrix composites, carbon—carbon composites, fiber-reinforced composites and nature-made composites. Applications of composites (7)

MECHANICAL BEHAVIOR OF ISOTROPIC AND ORTHOTROPIC MATERIALS: terminology of laminated fibre reinforced composite materials – Engineering constants for orthotropic materials – stress, strains, relation for plane stress in an orthotropic material (8)

UNIT-II

MECHANICAL BEHAVIOUR OF A LAMINA: Stress strain relations in a lamina of arbitrary orientation – strength of an orthotropic laminates – Basic strength theories – Determination of engineering constants – mechanics of materials approach. (15)

UNIT-III

MACHANICAL BEHAVIOUR OF A LAMINATE: Classical lamination theory – lamina stress - strain behavior – Resultant forces and moment in a laminate – Types of laminates – Strength and Stiffness of laminates - Interlaminar stress in laminates. (15)

UNIT-IV

PRODUCTION OF COMPOSITE MATERIALS & PRODUCTS: Matrix and their role – Principal types of fibre and matrix materials - Basic principle of production of composite materials & products - Advantages and Limitations of different processes. (7)

MOULDING AND FORMING OF COMPOSITES: Layup and curing – open and closed mould process hand layup techniques – filament winding – Pultrusion – Pulforming – Thermoforming – Injection moulding - blow moulding. (8)

TEXT BOOKS

1. Robert M.Jones.'Mechanics of composite Materials" McGrawHillbook co.1970.
2. Meier schwartyx "Composites materials Hand book".McGraw Hill Book co.1984.

REFERENCE BOOKS

1. Agarwal B.D. &Brout man LJ."Analysists and performance of Fibre composites, Johnwileay& sons.
2. Tery Richardson, "Composite – A design guide "Industrial press inc, NY,1987.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2		1	1	1	1	1	1	1		2	2	1	2
CO2	3	1	1	1	1	2	1	1	3	2		2	2	2	1
CO3	3	3	3			2	1	1	1	2		3	2	1	2
CO4	2	2	3	2	2	1		1	2	1	1	2	2	1	2

COMPUTER INTEGRATED MANUFACTURING
20ME-HC 12

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

UNIT I

INTRODUCTION TO CIM - Overview of Production Systems, the product life cycle, Automation in Production Systems, computer's role in CIM , CIM architecture , product related activities of a company- marketing engineering - production planning - plant operations - physical distribution- business and financial management.
(15)

UNIT II
COMPUTER AIDED QUALITY CONTROL - Computer in quality control, contact inspection methods, Non contact inspection methods, optical and non optical computer aided testing.

FMS - components of FMS , types , FMS workstation , Material Handling and Storage

COMPUTER AIDED MATERIAL HANDLING - Computer control on material handling , Work Transfer stations, Assembly Stations, Automated Storage Retrieved System (ASRS), Material Handling Systems: Automated Guided Vehicles (AGV), Conveyers, Computer Control System.
(15)

UNIT III
CELLULAR MANUFACTURING- Group Technology , Composite Part Concept-Machine Cell Design and Layout-Quantitative Analysis in Cellular Manufacturing.
Rank Order Clustering Method-Arranging Machines in A GT Cell-Hollier Method-Simple Problems

SHOP FLOOR CONTROL - Integration of Components Shop floor control , factory data collection system -automatic identification methods- Bar code & RFID technology
(15)

UNIT IV
Introduction to Just in time production systems, Lean production and agile manufacturing and fundamentals of Concurrent Engineering

Material Requirement Planning (MRP 1) – Manufacturing Resource Planning (MRP II) – Enterprise Resource Planning (ERP) - Advantages and limitations of above supporting systems.
(15)

Text Books :

1. Mikell. P. Groover “Automation, Production Systems and Computer Integrated Manufacturing”, 3rd edition, Pearson Education 2008.
2. CAD/CAM/CIM by P. Radhakrishnan, S. Subramanyan, V. Raju, New age publication,2nd edn,2004.

Ref Books :

1. Mikell. P. Groover and Emory Zimmers Jr.,“CAD/CAM”, Prentice hall of India Pvt.Ltd., 1998.
2. James A. Regh and Henry W. Kreabber, “Computer Integrated Manufacturing”, Pearson Edu 2nd edn, 2005.
3. Chris McMahon and Jimmie Browne, “CAD CAM Principles, Practice and Manufacturing Management”, Pearson Education 2nd edition, 2005.
4. Ranky, Paul G., “Computer Integrated Manufacturing”, Prentice hall of India Pvt. Ltd., 2005.
5. Yorem Koren, “ Computer Integrated Manufacturing”, McGraw Hill, 2005.

CO – PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	2	3					3		2	2	2	2
2CO2	2	2	3	2	3					3		2	2	2	2
CO3	2	2	3	2	3					3		2	2	2	2
CO4	2	2	3	2	3					3		2	2	2	2

PRODUCT DESIGN AND DEVELOPMENT
20ME-HC 13

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

1. The course aims at providing the basic concepts of product design, product features
2. Its architecture so that student can have a basic knowledge in the common features a product has and how to incorporate them suitably in product.
3. To understand the design for manufacturing and product development
4. To understand the embodiment design and new product development

Course Outcomes:

After completion of the course, the student would be able to

1. The student will be able to design some products for the given set of applications;
2. The knowledge gained through prototyping technology will help the student to make a prototype of a problem and hence product design and development can be achieved.
3. Analyze the set of potential innovation triggers and strategically select those opportunities that fit with the organizational resources and strategies.
4. Analyze the new product development

UNIT-I

Introduction - Concept Generation and Selection

Task – Structured approaches – clarification – search – externally and internally – explore systematically – reflect on the solutions and processes – concept selection – methodology – benefits. (14)

UNIT-II

Product Architecture: Implications – Product change – variety – component standardization – product performance -manufacturability – product development management – establishing the architecture – creation -clustering – geometric layout development – fundamental and incidental interactions – related system level design issues – secondary systems – architecture of the chunks – creating detailed interface specifications. (14)

UNIT-III

Design for Manufacturing and Product Development: Definition – Estimation of Manufacturing cost – reducing the component costs and assembly costs -Minimize system complexity – Prototype basics – principles of prototyping – planning for prototypes -Economic Analysis – Understanding and representing tasks – baseline project planning – accelerating the project – project execution. (14)

UNIT-IV

Embodiment Design: Introduction to embodiment design – product architecture – types of modular architecture –steps in developing product architecture Industrial design – human factors design –user friendly design (6)

New Product Development: Supporting techniques for new product development processes such as quality function deployment and quality engineering and Taguchi Method. (8)

TEXT BOOKS

3. Karl T. Ulrich, Steven D. Eppinger, Product Design and Development, Sixth Edition, McGraw-Hill, 2015.
4. A.K. Chitale, R.C. Gupta, Product Design and Manufacturing, Sixth Edition, Prentice –Hall of India, 2013.

REFERENCE BOOKS

1. Kemnneth Crow, Concurrent Engg./Integrated Product Development, DRM Associates, 26/3,Via Olivera, Palos Verdes, CA 90274(310) 377-569, Workshop Book.
2. Stephen Rosenthal, Effective Product Design and Development, Business One Orwin, Homewood, 1992, ISBN 1-55623-603-4.
3. Staurt Pugh, Tool Design -Integrated Methods for Successful Product Engineering, Addison Wesley Publishing, New york, NY.
4. Robert G. Cooper, Winning at New Products: Creating Value Through Innovation, Hachette Book Group, Newyork, 2017.
5. John Starc, Product Lifecycle Management (Decision Engineering), Springer Publications, 2015.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2		1		1	2		3	2	1		2	1	2	3
CO2	3		1		3	1	1	2		1		2		1	2
CO3	1	1	2		2	3	1		2	3	1		2		3
CO4	1		2	1	3	2	3	2		1	2		3	2	

ENTREPRENEURSHIP DEVELOPMENT

20ME-HC 14

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

5. To develop and strengthen the basic entrepreneurship knowledge for students
6. To impart basic entrepreneurial skills and understanding to run a business efficientlyand effectively.
7. To develop skills for registering a company and gain the knowledge on sources of funds and Establishing distribution network
8. To make the student aware MSMEs, Role and schemes of government in establishingenterprises in general and women entrepreneurship, social entrepreneurship in specific.

Course Outcomes:

Upon completion of the course, students will be able to

5. Understand the meaning of entrepreneur and able to visualize the benefits of being anentrepreneur
6. Unearth the entrepreneurial qualities hidden in them and apply them to the entrepreneurial activities
7. Understand the procedure for registering a company and gain the knowledge onsources of funds and Establishing distribution network
8. Realize the importance of MSMEs and the government support, formation and thecharacteristics of women entrepreneurship and social entrepreneurship

UNIT 1

Evolution of the concept of entrepreneurship, Meaning of Entrepreneur, functions of an entrepreneur, types of entrepreneurs, and stages in entrepreneurial process. (2)

Role of entrepreneurs in economic development, possible value creation by an enterprise - direct and indirect employment, government revenue, value to consumers in terms of quality products and services, export and import substitution. (6)

Challenges and opportunities of entrepreneurship – risk, return, professional fulfilment, spinoffs from academia – the Indian and global scenario, Factors Affecting Entrepreneurial growth. (6)

UNIT-II

FORMULATION OF BUSINESS UNIT: Building and Leading Effective Team. Selecting a balanced team and related issues. important Tasks for Starting a New Business. (4)

Market Research, identification of business opportunities, Identifying the products and/ or services, deciding on geographical location Market Feasibility study; technical, financial, and social feasibility study. (8)
Enterprise in project mode; identification, selection, project report need and significance; Project Appraisal Methods, (2)

UNIT-III

STARTING BUSINESS UNIT: Form of business organization, naming and registering/ incorporating a company, Raising funds, Sources of Fund, Raising loan fund, seed fund, equity capital, sources of grants/subsidies and margin money, loan restructuring and other concessions available to financially weak business units.Banking sources; Non-banking Institutions and Agencies.
Establishing distribution network, branding and acquiring strategic assets, product pricing (8)
Critical Success and Failure Factors. Legal Issues of Business, Corporate Governance and (2)
Business Ethics. (4)

UNIT-IVs

MICRO, SMALL AND MEDIUM ENTERPRISES (MSMEs): Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes. (4)
ENTREPRENEURSHIP DEVELOPMENT AND GOVERNMENT: Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available; Central/State agencies in the Entrepreneurship development.
(6)

WOMEN ENTREPRENEURSHIP: Concept of women entrepreneurship-Reasons for growth of woman entrepreneurship- Problems faced by them and remedial measures (2)SOCIAL ENTREPRENEURSHIP: Definition, types, examples, issues. (2)

TEXT BOOKS

4. Khanka. S.S., ‐Entrepreneurial Development‖ Chand& Co. Ltd., Ram Nagar, New Delhi, 2013.
5. Donald F Kuratko, ‐Entrepreneurship-Theory, Process and Practice**‖**, 9th Edition, Cengage Learning, 2014.
6. Raj Shankar, ‐Entrepreneurship: Theory and Practice**‖**,Vijay Nicole imprints Ltd in collaboration with Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2012.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1		2	1	2	1	2	2	2	1	2	1	2	1		1
CO2	1	2	2	2	1	1	2	2	2	3	3	3	2	2	2
CO3		1						2	1	3	2	2	1		
CO4		1						2	1	3	2	2	1		

SUPPLY CHAIN MANAGEMENT
20ME-HC 15

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

1. To enable the students understand the principles of SCM
2. To provide the details of planning of SCM and SCM integration
3. To acquire the knowledge of supply chain integration with push and pull systems.
4. To learn the concepts of coordination in SCM

Course Outcomes:

After completion of the course, Student will be able to

1. Implement SCM in industries
2. Possess the knowledge of supply chain and competitive advantage
3. Possess the knowledge of supply chain and integration
4. Applying the bull whip effect in SCM coordination

UNIT-I

Introduction to Logistics and Supply Chain Management: Definition: Supply Chain, Supply Chain Management- Decision Phases in Supply Chain Management – Process view of Supply Chain – Managing Uncertainty – Global Optimization – Importance of Supply chain Management – Key issues in Supply Chain Management.

UNIT-II

Competitive advantage: Competitive advantage – Gaining Competitive advantage through logistics – The Mission of Logistics Management - Integrated supply chains – Supply Chain and Competitive performance. The changing logistics environment - Models in Logistics Management - Logistics to Supply Chain Management.

UNIT-III

Supply Chain Integration: Introduction – Push, Pull and Push-Pull systems: Push based supply Chain, Pull Based supply chain, Push- Pull supply Chain – Demand Driven Strategies – Impact of Internet on Supply Chain Strategies – Distribution Strategies – Centralized Vs Decentralized control.

UNIT-IV

Coordination and Technology in SCM: Introduction – Bull Whip effect, Impact of Centralized information on the Bullwhip effect, Methods for coping with the Bull whip effect – Lead time reduction.

TEXT BOOKS

2. Chopra, S., and Meindl, P., Supply chain Management: Strategy, Planning and Operations. 2nd Edition, Pearson Education (Singapore) Pvt. Ltd, 2004.
3. Simchi-Levi, D., Kaminsky, P., and Simchi-Levi, E., Designing & Managing the Supply Chain: Concepts, Strategies & Case studies. Third Edition, McGraw-Hill Education, 2007.

REFERENCE BOOKS

1. Raghuram, G. and Rangaraj, N., Logistics and Supply Chain Management: Cases and Concepts, Macmillan India Limited, New Delhi, 2000.
2. Doebler, D.W. and Burt, D.N., Purchsing and Supply Chain Management: Text and Cases, McGraw-Hill Publishing Company Limited, New Delhi, 1996.
3. Christopher, M., Logistics and Supply Chain Management, Pitman Publishing Company, London, 1993.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2	3	1	2			2	3			3	2	3	1
CO2			2			3	3			1	2				1
CO3		3		3	2			3		2		2	3	2	2
CO4	2		3		2	1			2	2	3	2	3		2

TOTAL QUALITY MANAGEMENT
20ME-HC 16

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

1. To facilitate the understanding of Quality Management principles and process.
2. To know the importance of quality and various methods of quality and TQM.
3. To acquire the knowledge of different types of TQM principles.
4. Explain the importance of TQM Tools and principles. Acquire the knowledge of control charts theory.
5. To prepare a good quality systems with different ISO series in manufacturing sectors.

Course Outcomes:

After completion of the course, the student would be able to

1. Apply the tools and techniques of quality management to manufacturing and service processes.Identify and articulate how quality contributes to the achievement of an organization's strategic objectives.
2. Appraise and apply TQM principles as the basis of quality councils and quality circles.Describe the role of PDCA cycle and its importance in industry and
3. Apply Kaizen technique to a given case.Critically evaluate the TQM in manufacturing and service production sectors.
4. Get the solutions using new management tools for six sigma concepts. Give an example of QFD in detail. Recognize the importance of Quality systems with ISO series in production sectors.

UNIT-I

Introduction - Need for quality - Evolution of quality - Definitions of quality - Dimensions of product and service quality - Basic concepts of TQM - TQM Framework - Contributions of Deming, Juran and Crosby - Barriers to TQM - Quality statements - Customer focus - Customer orientation, Customer satisfaction, Customer delight, Customer complaints, Customer retention - Costs of quality. (14)

UNIT-II

TQM Principles: Leadership - Strategic quality planning, Quality Councils - Employee involvement - Motivation, Empowerment, Team and Teamwork, Quality circles Recognition and Reward, Performance appraisal - Continuous process improvement - PDCA cycle, 5S, Kaizen - Supplier partnership - Partnering, Supplier selection, Supplier Rating. (14)

UNIT-III

TQM Tools and Principles: The seven traditional tools of quality - New management tools - Six sigma: Concepts, Methodology, applications to manufacturing, service sector including IT - Bench marking - Reason to bench mark, Bench marking process - FMEA - Stages, Types. Concept of Just-in-time. (14)

UNIT-IV

Quality Function Deployment: House of Quality. (6)

Quality Systems: Need for ISO 9000 - ISO 9001-2008 Quality System - Elements, Documentation, Quality Auditing - QS 9000 - ISO 14000 - Concepts, Requirements and Benefits - TQM Implementation in manufacturing and service sectors (8)

TEXT BOOKS

1. Dale H Besterfield, (2008), Total Quality Management, Pearson Education
2. L.S. Srinath, (2005) Reliability Engineering, Affiliated East West Press, New Delhi

REFERENCE BOOKS

1. Juran's Quality Handbook by Joseph M. Juran and A. Blanton Godfrey, McGraw Hill, 2010
2. James R. Evans and William M. Lindsay, "The Management and Control of Quality", 8th Edition, First Indian Edition, Cengage Learning, 2012.
3. Suganthi.L and Anand Samuel, "Total Quality Management", Prentice Hall (India) Pvt. Ltd., 2006.
4. Janakiraman. B and Gopal .R.K., "Total Quality Management - Text and Cases", Prentice Hall (India) Pvt. Ltd., 2006.
5. Joel E. Rose, (1993), Total Quality Management, II Edition, Kogan Page Ltd., USA.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1		2					2				1	2	1	1
CO2	1		2		3					1				2	3
CO3	2		1							2					2
CO4	2		1		2	1				1	3		2		

MINOR COURSES

DEPARTMENT OF MECHANICAL ENGINEERING
MINOR COURSES OFFERED BY MECHANICAL ENGINEERING.

SUBJECT CODE	SUBJECT	L	T	P	Credits
20ME-MC1	Elements of Mechanical Engineering	4	0	0	4
20ME-MC2	Engineering Mechanics	4	0	0	4
20ME-MC3	Engineering economics and financial analysis	4	0	0	4
20ME-MC4	3D printing	4	0	0	4
20ME-MC5	Mechatronics	4	0	0	4
20ME-MC6	Entrepreneurship development	4	0	0	4
20ME-MC7	Automobile Engineering	4	0	0	4
20ME-MC8	Thermal engineering	4	0	0	4
20ME-MC9	Nonconventional energy sources	4	0	0	4
20ME-MC10	Industrial Robotics	4	0	0	4
20ME-MC11	Manufacturing Science	4	0	0	4
20ME-MC12	Fundamentals of Mechanical Design	4	0	0	4

ELEMENTS OF MECHANICAL ENGINEERING
20ME-MC1

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:
To make the students to learn fundamental topics of mechanical engineering and to impart basic knowledge of mechanical systems, equipment and process

Course Outcomes:
Upon successful completion of the course, the student will be able to

CO1: Describe the Energy sources and fundamental concepts and laws of thermodynamics.

CO2: Understand the principle of operation of different I.C. engines and their applications

CO3: Acquire basic knowledge of material behaviour under load and Transmission of Power

CO4: Identify basic manufacturing methods and principles of joining process

UNIT-I

ENERGY RESOURCES: Introduction, Classification of Energy Resources, Conventional Energy Resources: working principle of Steam power plant, Nuclear Power plant, Non-conventional Energy Resources: Working principle of Solar Power plant, Wind power plant
(7)

BASICS OF THERMODYNAMICS: Introduction and definition of thermodynamics, Dimensions and units, systems, surroundings and universe, Reversibility and Irreversibility, Quasi-static process, Energy, Heat and Work. Introduction to Law of Thermodynamics: Zeroth Law of Thermodynamics, First law of thermodynamics and Second law of thermodynamics
(8)

UNIT-II

IC ENGINES: Introduction, Main components of IC engines, working of 4-stroke petrol engine and diesel engine, working of 2- stroke petrol engine and diesel engine, difference between petrol and diesel engine, difference between 4- stroke and 2- stroke engines.
(8)

PROPERTIES OF MATERIALS: Classification of materials, Properties of Materials: Mechanical properties – Physical properties – Thermal Properties - Electrical properties - Magnetic Properties (7)

UNIT-III

SIMPLE STRESS AND STRAINS: Introduction to Stress and Strain – Types of stresses & strains – Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain- Elastic moduli & the relationship between them
(8)

POWER TRANSMISSION ELEMENTS: Introduction, Elements of Power Transmission, Shafts, Power transmission Drives, Belt Drives, Types of belt Drives, Power Transmission by Gear Drives, Classification of Gears

(7)

UNIT-IV

MANUFACTURING METHODS: Casting: Principles of Casting, Advantages & disadvantages, Applications of casting, Lathe: Description, Main components, Basic operations performed on a Lathe (Turning, Taper turning, Thread cutting, Drilling) Welding: Types of welding, Principles of Gas Welding and Arc Welding, Applications, Advantages & disadvantages of welding, Brazing & Soldering

(15)

TEXT BOOKS

1. Elements of Mechanical Engineering by V. K. Manglik, Prentice Hall India Learning Private Limited, New Delhi, 2013

REFERENCE BOOKS

4. Elements of Mechanical Engineering by R. K. Raj Put, Laxmi Publications, New Delhi, 7th Edition 2014,
5. Elements of Mechanical Engineering by Dr. Sadhu Singh., S. Chand & Company Limited, New Delhi, Revised Edition 2013
6. A Text Book of Elements of Mechanical Engineering by K. R. Gopalkrishna, Subhash Publishers, Bangalore, 2015
7. Strength of Materials by R. K. Bansal, Laxmi Publications, New Delhi, 6th Edition, 2022

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1		1								2	1	
CO2	3		2		2								2	2	1
CO3	3		2		2								2	2	
CO4	3		1		1								2	1	3

ENGINEERING MECHANICS
20ME-MC2

Lectures	3	Tutorial	1	Practical	0	Credits	4
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

To introduce the students to basic laws and principles of Engineering Mechanics with emphasis on the analysis and application to practical Engineering problems, where bodies and systems are in static and dynamic condition.

Course Outcomes:
Upon successful completion of the course, the student will be able to

CO1: Find the resultant and analyse the equilibrium of a coplanar concurrent and parallel force systems.

CO2: Deduce the centroids of areas, composite areas area moment inertia of standard sections

CO3: To apply the concepts of kinematic in solving the problems in rectilinear and curvilinear motions.

CO4: To learn the concepts of kinetics and solve the problems in when the body is in pure rotation and translation

UNIT-I

Introduction to Engineering Mechanics: Force systems: Basic Concepts, Resultant of coplanar concurrent forces, Moment of force and its applications, couples and resultant of force systems, Equilibrium of Force Systems, Free body diagram, Equations of equilibrium, Equilibrium of planar system. (10)

Trusses: Introduction, Analysis of trusses by method of joints (5)

UNIT-II

Centroid: Centroid of simple figures from basic principles, centroid of composite sections (5)

Center of Gravity: Center of gravity of simple body from basic principles, Center of gravity of composite bodies, Pappus theorems (5)

Area Moment of Inertia: Definition – Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures (5)

UNIT-III

Kinematics: Rectilinear and Curvilinear motions – Velocity and Acceleration – Motion of Rigid Body – Types and their Analysis in Planar Motion. (15)

UNIT-IV

Kinetics: Equations of motion of a particle and a rigid body in translation-Equations of a body in pure rotation and plane motion (15)

TEXT BOOKS

1. Engineering Mechanics (in SI units) by S Timoshenko, D H Young, J V Rao and Sukumar Pati, McGraw Hill Education, 5th edition, 2016.

2. Engineering Mechanics: Statics and Dynamics by A K Tayal, Umesh publications, 14th edition, 2015

REFERENCE BOOKS

1. Vector mechanics for Engineers: Statics and Dynamics by Ferdinand Beer, E Russell Johnston Jr, David Mazurek, Phillip Cornwell, Brian Self and Sanjeev Sanghi, McGraw Hill Education, 11th edition, 2017.

2. Engineering Mechanics: Statics and Dynamics by R C Hibbeler, Pearson, 14th edition, 2017.

3. Engineering Mechanics (Statics) by J L Meriam and L G Kraige, Wiley student edition, 7th edition.

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3		1		2								2	1	
CO2	3		1		2								2	2	
CO3	3		1		2								2	2	
CO4	3		1		2								2	1	

ENGINEERING ECONOMICS AND FINANCIAL ANALYSIS
20ME-MC3

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

1. To provide the concepts of economics and evaluation of alternatives.
2. To calculate the depreciation, to acquire skills of costing methods and carry out break-even analysis
3. To understand financial statements and analyze them
4. To provide the basics of project management

Course Outcomes:

Upon successful completion of this course, students will acquire the skills to apply the basics of economics and cost analysis to engineering and take economically sound decisions and be able to

1. Discuss the basics of economics and evaluate the alternatives based on economical aspect.
2. Apply the concept of depreciation, costing and breakeven analysis by calculation.
3. Analyze financial statements and concepts of working capital management, and capital budgeting.
4. Determine the critical path and the estimated time of completion for a given project work.

UNIT-I

Economics: Relation between Science, Engineering, Technology and Economic Development, Factors of Production
(4)

Evaluation of Alternatives: Time Value of Money, Cash Flow Analysis, Economic Equivalence, Present worth analysis, Annual Equivalence Analysis, Rate of Return Analysis, (10)

UNIT-II

Depreciation: Definition, causes of depreciation, Methods of Depreciation: Straight line method, Declining balance method, Sum of the years digits method. (4)

Costing: Cost Concepts, Elements of Cost, Unit Costing, Job Costing and Process Costing. (6)

Break-Even Analysis: Assumptions,Break–EvenCharts, Simple problems. (4)

UNIT-III

Financial Management: Scope, Objectives and functions of Financial Management**;** Reading Profit &Loss account and Balance sheet. Ratio Analysis, Problems. (10)

Working Capital Management*:* Concepts and Objective. Need for Working Capital, Estimation of Working Capital (4)

Capital Budgeting: Definition, Objectives and Process. (2)

UNIT-IV

Project Management: Introduction, Project Life Cycle, Project Schedule Planning, Work Breakdown Structure, CPM and PERT – Problems (12)

TEXT BOOKS

1. Theusen and Theusen: Engineering Economy, PHI
2. Engineering Economics by R Panneerselvam, PHI Learning.
3. Financial Management by Prasanna Chandra, McGraw Hill India.
4. Principles of Financial Engineering (Academic Press Advanced Finance) 3rd Editionby Robert Kosowski , Salih N. Neftci,
5. Project Management: The Managerial Processby Erik Larson and Clifford Gray, McGraw Hill Education

REFERENCE BOOKS

1. Degarmo, E.P., Sullivan, W.G and Canada, J.R, "Engineering Economy", Macmillan, New York, 2011.
2. Zahid A khan: Engineering Economy, Dorling Kindersley, 2012
3. CPM and PERT by Wesley, PHI.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	2		2				1			2		2	1	
CO2	3	3		3				2			2		3	2	
CO3	2	2		2				2			3		2	2	
CO4	3	3		3				2			2		3	3	

3D PRINTING
20ME-MC4

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

COURSE OBJECTIVES

The student will be able to

1. To gain knowledge and skills related to 3D printing technologies.
2. To learn the selection of material, equipment and development of a product for Industry 4.0 environment.
3. To understand the various software tools, process and techniques for digital manufacturing.
4. To apply these techniques into various applications.

COURSE OUTCOMES

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

1. Develop CAD models for 3D printing, data exchange.
2. Select a specific material for the given application.
3. Select a 3D printing process for an application.
4. Produce a product using 3D Printing or Additive Manufacturing (AM).

PRE-REQUISITES

Computer Aided Design & Drafting
Engineering Materials

UNIT-I

3D Printing (Additive Manufacturing) : Introduction, Process, Classifications, Advantages, Additive v/s Conventional Manufacturing processes, Applications. **(6 Hours)**

CAD for Additive Manufacturing :CAD Data formats, Data translation, Data loss, STL format. **(4 Hours)**

UNIT-II

Additive Manufacturing Techniques: Stereo- Lithography, LOM, FDM, SLS, SLM, Binder Jet technology.Process, Process parameter, Process Selection for various applications. Additive Manufacturing Application Domains: Aerospace, Electronics, Health Care, Defence, Automotive, Construction, Food Processing, Machine Tools **(10 Hours)**

UNIT-III

Materials: Polymers, Metals, Non-Metals, Ceramics Process, Process parameter, Process Selection for various applications. Various forms of raw material- Liquid, Solid, Wire, Powder; Powder Preparation and their desired properties, Polymers and their properties. **(6 Hours)**
Support Materials:Types of support materials, geometric related support, reduction of wastage. **(4 Hours)**

UNIT-IV

Additive Manufacturing Equipment: Process Equipment- Design and process parameters, Governing Bonding Mechanism, Common faults and troubleshooting , Process Design **(4 Hours)**

Post Processing: Requirement and Techniques: Support Removal, Sanding, Acetone treatment, polishing,

Product Quality: Inspection and testing, Defects and their causes **(6 Hour)**

LIST OF PRACTICALS **(10 Hour)**

1. 3D Modelling of a single component.
2. Assembly of CAD modelled Components
3. Exercise on CAD Data Exchange.
4. Generation of .stl files.
5. Identification of a product for Additive Manufacturing and its process plan.
6. Printing of identified product on an available AM machine.
7. Post processing of additively manufactured product.
8. Inspection and defect analysis of the additively manufactured product.
9. Comparison of Additively manufactured product with conventional manufactured counterpart.

Reference Books

1. Lan Gibson, David W. Rosen and Brent Stucker, “Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
2. Andreas Gebhardt, “Understanding Additive Manufacturing: Rapid Prototyping, Rapid Tooling, Rapid Manufacturing”, Hanser Publisher, 2011.
3. Khanna Editorial, “3D Printing and Design”, Khanna Publishing House, Delhi.
4. CK Chua, Kah Fai Leong, “3D Printing and Rapid Prototyping- Principles and Applications”, World Scientific, 2017.
5. J.D. Majumdar and I. Manna, “Laser-Assisted Fabrication of Materials”, Springer Series in Material Science, 2013. L. Lu, J. Fuh and Y.S. Wong, “Laser-Induced Materials and Processes for Rapid Prototyping”, Kulwer Academic Press, 2001.
6. Zhiqiang Fan And Frank Liou, “Numerical Modeling of the Additive Manufacturing (AM) Processes of Titanium Alloy”, InTech, 2012

CO-PO mapping

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PS O1	PS O2	PSO3
CO1	1		1		1			1			1		2	1	1
CO2	2		1		2			1			1		2	2	1
CO3	3		2		2			3			2		1	3	2
CO4	3		2		3			2			2		3	2	1

MECHATRONICS
20ME-MC5

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

1. To describe basic elements of mechatronics systems and signal conditioning theory
2. To analyze basic system models ,building blocks and analogy between various systems
3. To derive response of systems to step input
4. To describe the functioning of various modes of system control
5. To apply knowledge and able to design a typical mechatronic system

Course Outcomes:

At the end of the course students will be able to

1. define various static performance terms of sensors
2. write mathematical model of various systems
3. Understand the working of various controllers
4. Write simple ladder programs for various applications

UNIT-I

INTRODUCTION TO MECHATRONICS: Sensors & transducers: Introduction, performance terminology, classification of sensors, selection of sensors. Signal Conditioning: Introduction to data acquisition – Quantizing theory, analogue to digital conversion, digital to analogue conversion. Data Presentation Systems: Data presentation elements magnetic displays, data acquisition systems, systems measurement, testing and calibration.

UNIT-II

ACTUATION SYSTEMS: Pneumatic and hydraulic actuation systems, stepper motors.

SYSTEM MODELS: Modelling of one and two degrees of freedom, mechanical, electrical, fluid and thermal systems. Block diagram representations for these systems.

UNIT-III

DYNAMIC RESPONSE OF SYSTEMS: Zero order, First order and second order systems. Block diagram representation, Transfer function. Systems in series, Systems with feedback loops.

CLOSED LOOP CONTROLLERS: Continuous and discrete processes control modes, two step, proportional, derivative, integral, PID controllers.

UNIT-IV

PLC : Introduction, basic structure, I/P, O/P, processing, programming, ladder diagrams, timers, internal relays and counters, data handling, analogue input and output selection of PLC.

DESIGN: Designing of mechatronics systems, possible design solutions, case studies of mechatronics systems – pick and place robot. Role of magnetic bearings in mechatronics. Introduction to industry 4.0.

TEXT BOOKS

1. William Bolton, "Mechatronics-A Multidisciplinary approach", 4th edition-2010, Pearson Education.
1. Godfrey C. Onwubolu, "Mechantronics-Principles and Applications" Butterworth-Heinemann-An Imprint of Elsevier-2006.

REFERENCE BOOKS

1. Devdasshetty, Richard A kolk, "Mechatronics system Design" 2nd edition, Cengage Learning (India) Pvt Ltd
2. M.D.Singh, J.G.Joshi, "Mechatronics" 2nd print, PHI Learning Private Limited.
3. David G Alciatore, Michael B Histand,"Introduction to Mechatronics and Measurement systems" Tata mc Graw hill publishing company Limited.
4. Newton C Braga, "Mechatronics source book" Ist Indian print, Cengage Learning (India) PvtLtd..
5. W.Bolton, "Industrial control and Instrumentation" Universities Press (India) Private Limited.
6. W.Bolton, "Programmable Logic Controllers" 4th edition, Newnens-An Imprint of Elsevier.
7. Akira Chiba Tadashi Fukao Osamu Ichikawa Masahide Oshima Masatugu Takemoto David Dorrell, "Magnetic Bearings and Bearingless Drives" 1st edition, Newnens-An Imprint of Elsevier.

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2														
CO2		2		1											
CO3	1														
CO4	1	1													

ENTREPRENEURSHIP DEVELOPMENT

20ME-MC6

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

1. To develop and strengthen the basic entrepreneurship knowledge for students
2. To impart basic entrepreneurial skills and understanding to run a business efficiently and effectively.
3. To develop skills for registering a company and gain the knowledge on sources of funds and Establishing distribution network
4. To make the student aware MSMEs, Role and schemes of government in establishing enterprises in general and women entrepreneurship, social entrepreneurship in specific.

Course Outcomes:

Upon completion of the course, students will be able to

1. Understand the meaning of entrepreneur and able to visualize the benefits of being anentrepreneur
2. Unearth the entrepreneurial qualities hidden in them and apply them to the entrepreneurial activities
3. Understand the procedure for registering a company and gain the knowledge onsources of funds and Establishing distribution network
4. Realize the importance of MSMEs and the government support, formation and thecharacteristics of women entrepreneurship and social entrepreneurship

UNIT 1

ENTREPRENEURSHIP

Evolution of the concept of entrepreneurship, Meaning of Entrepreneur, functions of an entrepreneur, types of entrepreneurs, and stages in entrepreneurial process. (2)

Role of entrepreneurs in economic development, possible value creation by an enterprise - direct and indirect employment, government revenue, value to consumers in terms of quality products and services, export and import substitution. (6)

Challenges and opportunities of entrepreneurship – risk, return, professional fulfilment, spinoffs from academia – the Indian and global scenario, Factors Affecting Entrepreneurial growth. (6)

UNIT-II

FORMULATION OF BUSINESS UNIT:

Building and Leading Effective Team. Selecting a balanced team and related issues. important Tasks for Starting a New Business. (4)

Market Research, identification of business opportunities, Identifying the products and/ or services, deciding on geographical location Market Feasibility study; technical, financial, and social feasibility study. (8)

Enterprise in project mode; identification, selection, project report need and significance; Project Appraisal Methods, (2)

UNIT-III

STARTINGA BUSINESS UNIT: Form of business organization, naming and registering/ incorporating a company, (4)

Raising funds, Sources of Fund, Raising loan fund, seed fund, equity capital, sources of grants/subsidies and margin money, loan restructuring and other concessions available to financially weak business units.Banking sources; Non-banking Institutions and Agencies. (8)

Establishing distribution network, branding and acquiring strategic assets, product pricing Critical Success and Failure Factors. Legal Issues of Business, Corporate Governance and (2)
Business Ethics. (4)

UNIT-IV

MICRO, SMALL AND MEDIUM ENTERPRISES (MSMEs): Definition and Significance in Indian Economy; MSME Schemes, Challenges and Difficulties in availing MSME Schemes. (4)

ENTREPRENEURSHIP DEVELOPMENT AND GOVERNMENT: Role of Central Government and State Government in promoting Entrepreneurship - Introduction to various incentives, subsidies and grants - Export Oriented Units - Fiscal and Tax concessions available; Central/State agencies in the Entrepreneurship development. (6)

WOMEN ENTREPRENEURSHIP:

Concept of women entrepreneurship-Reasons for growth of woman entrepreneurship-Problems faced by them and remedial measures (2)

SOCIAL ENTREPRENEURSHIP: Definition, types, examples, issues. (2)

TEXT BOOKS

1. Khanka. S.S., ‐Entrepreneurial Development‖ Chand& Co. Ltd., Ram Nagar, New Delhi, 2013.
2. Donald F Kuratko, ‐Entrepreneurship-Theory, Process and Practice‖, 9th Edition, Cengage Learning, 2014.
3. Raj Shankar, ‐Entrepreneurship: Theory and Practice‖,Vijay Nicole imprints Ltd in collaboration with Tata McGraw Hill Publishing Co. Ltd., New Delhi, 2012.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1	2		2		3						2	2		1
CO2	2	2	2		2		2				2		2		2
CO3	2	2		2		2	2		3	3			2		2
CO4	1	3	2		2		2	3				2	1		2

AUTOMOBILE ENGINEERING

20ME-MC7

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

To make the students to

1. Familiarize the fundamentals of Engine Components, Chassis and suspension system, braking and transmission system, and cooling and lubrication system.
2. Develop a strong base for understanding future developments like hybrid and electric vehicles in the automobile industry.

Course Outcomes:

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

1. List different types of Vehicles and their applications.
2. Define working of Automobile Engine cooling and lubrication system.
3. Describe functioning of Ignition system and its accessories.
4. Describe functioning of Transmission, Steering, and Braking and Suspension system

UNIT-I

INTRODUCTION: Classification of vehicles – applications, valves, valve arrangements and operating Mechanisms, Piston - design basis, types, piston rings, firing order; Crankshafts, Flywheel, Air and Fuel Filters, Mufflers. (8)

FUEL SUPPLY SYSTEMS: Fuel supply pumps, Mechanical and Electrical type Diaphragm pumps. (3)

COOLING SYSTEMS: Need for cooling system, Air and water cooling, Thermal syphon cooling systems (4)

UNIT-II

LUBRICATING SYSTEMS: Various lubricating systems for I.C. Engines. (3)

ELECTRICAL SYSTEM: Ignition system, Spark plugs, Distributor, Electronic Ignition, Alternator, cutout, Current and voltage regulators, charging circuit, starting motors, lighting, instruments and accessories. (9)

CHASSIS: Introduction, Construction, Requirements of Chassis. (3)

UNIT-III

TRANSMISSION: Gear Box - Theory, Four speed and Five Speed Sliding Mesh, Constant mesh & synchromesh type, selector mechanism, automatic transmission, overdrive, propeller shaft, differential - principle of working. (8)

SUSPENSION SYSTEMS: Need for suspension systems, springs, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment. (7)

UNIT-IV

VEHICLE CONTROL: Steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic). (6)

ELECTRIC, HYBRID AND FUEL CELL VEHICLES: Layout of electric and hybrid vehicles – Advantages and drawbacks, System Components, Electronic control system, Different configurations of electric and hybrid

vehicles hybrid vehicles, Power split device, High energy and power density batteries – Basics of fuel cell vehicles. (9)

TEXT BOOKS

1. Automobile Engineering - G.B.S.Narang.
2. Automobile Engineering -R.B.Gupta

REFERENCE BOOKS

1. Automotive Mechanics - Joseph Heitner
2. Automobile Engineering -S. Srinivasan
3. Automobile Engineering - Vol I & II - Kirpal Singh

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	2	2										2	1		
CO2	3	2	1		2	2		2		3		2	2	2	
CO3	3	2	2	1						2		2	2	1	1
CO4	2	3	3	2	2	2	3		1		1	2	2	2	3

THERMAL ENGINEERING

20ME-MC8

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

To make the students to understand and describe the fundamental concepts of thermal engineering.

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Discuss the fundamental concepts and laws of thermodynamics.
CO2: Demonstrate the working principles and fuels of IC engines.
CO3: Describe the basic concepts heat transfer, Refrigeration and air conditioning.
CO4: Describe the working of power plants.

UNIT-I

FUNDAMENTAL CONCEPTS AND DEFINITIONS: Introduction, properties and state of a substance, Thermodynamic equilibrium and Quasi-static Process, Thermodynamic path, cycle, Path function and Point function, Internal energy and Enthalpy work and heat, Displacement work, Displacement work in various Quasi-Static processes

LAWS OF THERMODYNAMICS: Zeroth law of thermodynamics, first law of thermodynamics and second law of thermodynamics (4)

UNIT-II

INTERNAL COMBUSTION ENGINES: Introduction, Basic engine nomenclature, Classification, Working of SI and CI engines (Both 4-stroke and 2-stroke engines).

ALTERNATIVE FUELS: Liquid fuels - Alcohol, Methanol, Ethanol, Gaseous fuels –Hydrogen, Natural Gas and Liquefied Petroleum and Bio Fuels.

UNIT-III

Heat Transfer: Introduction, modes of heat transfer, types and working of heat exchangers

REFRIGERATION: Need for Refrigeration, Definitions, Methods of refrigeration, principles of Vapor compression refrigeration system and Vapor absorption refrigeration cycle

AIR CONDITIONING: Introduction, Types and working of Air conditioning systems

UNIT-IV

POWER PLANTS: Introduction to various Energy sources, types of power plants- hydro electric power plant, thermal power plant, nuclear power plants and gas turbine power plant.

TEXT BOOKS

1. Engineering Thermodynamics- P.K.Nag, TMH, New Delhi.
2. Thermal Science and Engineering- D.S.kumar, S.K.Katariapubl, New Delhi.

REFERENCE BOOKS

1. Thermodynamics—Rajput, LaxmiPubl, New Delhi.
2. Fundamentals of Engineering Thermodynamics-Rathakrishnan-PHI, New Delhi.
3. Thermodynamics -- J.P.Holman, MGH, New York.
4. Engineering Thermodynamics—Cengel& Boles, TMH

CO-PO MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2		1			2							2		
CO2	2		2			2	2	2					2	2	
CO3	2	1	2			2	2	2					2	2	
CO4	2		1			2	2	2					1	2	

NON-CONVENTIONAL ENERGY SOURCES

20ME-MC9

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

CO 1: To enable students to identify different sources of non conventional energy and innovative Technologiesin harnessing energy from these sources.
CO 2: Understand the energy conversion from wind energy, geothermal energy, Biomass, biogas, fuel cells. CO 3: Understand the advantages and limitations of different non conventional energy sources and identify awide variety of applications for non conventional energy.

Course Outcomes: At the end of the course, the student will be able to
CO-1: understand different methods of exploiting solar energy.
CO-2: Understand the principles and energy conversion from wind and geo thermal sources
CO-3: Gain knowledge in exploring the energy from ocean, tidal and bio-mass
CO-4: understand the techniques in power generation using Fuel cells, bio gas and MHD

UNIT-I

Various non-conventional energy resources- Introduction, availability, classification, relative merits and demerits **Solar Energy:** Extra terrestrial solar radiation - terrestrial solar radiation –solar radiations on earth-measurement of solar radiations-solar constant-solar collectors-flat plate collectors-concentrating collectors-solar thermalconversion-solar thermal central receiver systems - photovoltaic energy conversion - solar cells- energy storage methods-applications of solar energy

UNIT-II

Wind energy: Availability of wind energy in India, site selection-Components of wind energy conversion systems-Classification of wind energy conversion systems-vertical axis and horizontal axis wind turbines- Performance characteristics-Betz criteria coefficient-applications of WECS-environmental aspects
Geo thermal Energy: Structure of earth's interior-geothermal sites-geothermal resources-Site selection for geothermal power plants-Principle of working-various types of geothermal power plants-applications

UNIT-III

Ocean thermal energy conversion (OTEC): Principle of ocean thermal energy conversion-Open cycle andclosed cycle OTEC plants-Merits and demerits
Tidal Power: Tides and waves as sources of energy-fundamentals and use of tidal energy-limitations of tidalenergy conversion system
Bio mass: Availability of biomass and its conversion techniques-bio mass gasification-bio mass resource development in India

UNIT-IV

Bio Gas: Bio gas production, aerobic and anaerobic bio conversion process-Properties of bio gas-classificationof biogas plants-advantages and disadvantages-bio gas applications

Fuel Cells: Classification, Principle of working of various types of fuel cells, merits and demerits, future potentialof fuel cells.

Magneto-Hydrodynamics (MHD): Principle of working of MHD Power plant, Classification, advantages anddisadvantages.

Energy storage methods- **Batteries,** super capacitors, **compressed air,** superconducting magnet energy storage, Regenerative fuel cell storage.

TEXT BOOK:

1. H.P. Garg& Jai Prakash, Solar Energy: Fundamentals and Applications, Tata McGraw Hill,New Delhi
2. Non-Conventional Energy Sources by G.D.Rai, Khanna Publisher
3. B H Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw HillEducation Pvt Ltd, 2011

REFERENCE BOOKS:

1. Power plant technology by EL-Wakil, McGraw-Hill.
2. Renewable Energy Sources by John Twidell& Toney Weir: E&F.N. Spon

CO-PO MAPPING

Course Outcomes	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	1		2		2			2	1					2	1
CO2			2				2								
CO3		1			1				1			1		1	1
CO4	3		2		2	2				2		2			2

INDUSTRIAL ROBOTICS
20ME-MC 10

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

Course Objectives:

5. To provide the student with knowledge of classification of robots and application of robots
6. To develop the student's knowledge in various end effectors of robots and programming of robots including various programming languages.
7. To provide the student with sufficient knowledge of various sensory devices and their working principles and applications in robots.
8. To develop student's skills in performing spatial transformations associated with rigid body motions and to perform kinematics analysis of robot systems

Course Outcomes:

After completion of the course the student must be able to

5. Acquire knowledge on basic structure & development of Industrial robots
6. Understand various types of end effectors & methods of programming a robot
7. Plan and execute sensors used in robots
8. Solve transformation and kinematic problems of robots

UNIT-I

Introduction to Robotics: major components of a robot, robotic like devices, classification of robots– Classification by coordinate system and by control method, Specifications of robots, fixed versus flexible automation, economic analysis, overview of robot applications. (15)

UNIT-II

Robot end Effectors: Introduction, end effectors, interfacing, types of end effectors, grippers and tools, considerations in the selection and design of remote centered devices. Various methods of programming robots: Robot programing languages (15)

UNIT-III

Robotic sensory devices: Sensor Characteristics, Position sensors, Velocity sensors, Acceleration sensors, Force and pressure sensors, Torque sensors, micro switches, light and Infrared sensors, Touch and Tactile sensors, Proximity sensors & Range finders. (15)

UNIT-IV

Transformations and Kinematics: Objectives, homogenous coordinates, basic transformation operations, forward solution – Denavit Hartenberg procedure. Simple problems involving planar manipulators, inverse or backward solution – problems involved, Introduction to Trajectory Planning, the manipulator jacobian. (15)

TEXT BOOKS

3. Mikell P Groover, Mitchel Weiss, Roger N Nagel, Nicholas G Odrey, Ashish Dutta, "Industrial Robotics- Technology, Programming and Applications" ,2 edition, McGraw Hill Education (India) Private Limited, New Delhi 2013
4. Saeed B. Niku, "Introduction to Robotics- Analysis, Systems, Applications", 1st edition, Prentice-Hall of India Private Limited, New Delhi 2007

REFERENCE BOOKS

4. R. K. Mittal, I. J. Nagarth, “Robotics and Control” Tata McGraw Hill Publishing Company Limited, 2005.
5. K.S. Fu, R.C. Gonzalez, C.S.G. Lee, ”ROBOTICS Control, Sensing, Vision and Intelligence” 1987, McGraw-Hill Book Company,
6. S. R. Deb, “Robotics Technology and Flexible Automation” 2006, Tata McGraw-Hill Publishing Company Limited.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2													
CO2	2	1	1												
CO3	3	1	3												
CO4	2	3	3												

BAPATLA ENGINEERING COLLEGE:: BAPATLA
(Autonomous)

MANUFACTURING SCIENCE
20ME-MC 11

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			0	Semester End Examination (3 Hours)			0

UNIT-1:

Introduction: Meaning, Origin, development, and Importance in the national economy

Engineering Materials: Structure and properties of engineering materials, phase diagrams, heat treatment, stress-strain diagrams for engineering materials.

UNIT-2:

Basic Manufacturing processes: Casting, Forming and Joining Processes: Different types of castings, design of patterns, moulds, and cores; solidification and cooling; riser and gating design. Plastic deformation and yield criteria; fundamentals of hot and cold working processes; load estimation for bulk (forging, rolling, extrusion, drawing) and sheet (shearing, deep drawing, bending) metal forming processes; principles of powder metallurgy. Principles of welding, brazing, soldering and adhesive bonding.

UNIT:3

Metal cutting and Machine tools:

Machine Tools:

i) Lathe: Principle, construction, types, operations, Turret/capstan, semi/Automatic, Tool layout

ii) Shaper, slotter, planer: Construction, operations & drives.

iii) Milling: Construction, Milling cutters, up & down milling. Dividing head & indexing. Max chip thickness & power required.

iv) Drilling and boring: Drilling, boring, reaming tools. Geometry of twist drills.

Grinding & Super finishing:

i) Grinding: Grinding wheels, abrasive & bonds, cutting action. Grinding wheel specification. Grinding wheel wear-attritions wear, fracture wear. Dressing and Truing. Max chip thickness and Guest criteria. Surface and cylindrical grinding. Centerless grinding.

ii) Super finishing: Honing, lapping, and polishing

UNIT:4: Unconventional Machining & Advances in Manufacturing:

Introduction to Unconventional Machining and Welding Need & benefits, application and working principle of EDM, ECM, LBM, EBM, USM. AJM, WJM. Similarly, non-conventional welding applications such as LBW, USW, EBW, Plasma-arc welding, Diffusion welding, Explosive welding/cladding. Introduction to Hybrid machining processes.

CAD/CAM/CIM: Introduction, Origin, Benefits, their integration tools, and applications

Textbooks:

Production Technology-R.K. Jain Khanna Publishers.

Introduction to Manufacturing Processes-John A. Schey, McGraw-Hill.

CO – PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	1					1	1	1	1			1	1		
CO2	2	1	1			1	2	1	1		1	1	1		
CO3	1		1		1		2		1		1	2	1		
CO4	2	1	1			1	1	1	1		1	1	1		

BAPATLA ENGINEERING COLLEGE:: BAPATLA
(Autonomous)

FUNDAMENTAL OF MECHANICAL DESIGN
20ME-MC12

Lectures	4	Tutorial	0	Practical	0	Credits	4
Continuous Internal Assessment			30	Semester End Examination (3 Hours)			70

Course Objectives:

1. To give knowledge on basic design procedure of mechanical elements, material properties and selection of materials.
2. To understand the design of common mechanical elements like brakes, clutches, belts, riveted joints and welded joints

Course Outcomes:

Upon successful completion of the course, the student will be able to

CO1: Understand the basic design procedure, selection of materials and understanding simple stresses and strains under static condition
CO2: Design the riveted joints and welded joints and to find efficiency under given loading conditions.
CO1: Determine the dimension of belt like length, width and thickness for maximum power transmission
CO1: Understand the various types of mechanical braking systems and types of clutches and their design

UNIT-I

Basics: Basic procedure of machine design, requirements and design of machine elements, traditional design methods. Use of standards in design, Common engineering materials and their properties and applications (5)

Design for Static Strength: Simple Stresses, Combined stresses, Torsional and bending stresses, stress strain relation, modulus of elasticity, poisons ratio, Factor of safety and its importance in design. (7)

UNIT-II

Riveted Joints: Types of riveted joints, Failures of riveted joints, Efficiency of riveted joints (6)

Welded Joints: Types of welded joints, Design of butt and fillet welded joints (6)

UNIT-III

Belt Drives: Flat and V-belts, Belt constructions, Geometrical relationships, Analysis of belt tensions, condition for maximum power, centrifugal tension and initial tension, Selection of Flat-belts, Selection of V- belts (12)

UNIT-IV

Brakes and Clutches: - Introduction to Brakes, Types, Analysis and design of block brakes, band brakes, external shoe brakes, pivoted shoe brakes, Temperature rise, Friction materials, Clutches, Analysis and design of simple and multiple disc clutches, friction materials, comparison of brakes and clutches. (12)

TEXT BOOKS

1. Bhandari, “Design of machine elements”, Tata McGraw Hill book Co, Fourth edition, 2017.
2. Joseph Shigley,Charles Mischke, Richard Budynas and Keith Nisbett “ Mechanical Engineering Design”, Tata McGraw-Hill book Co, Tenth edition,2020.
3. Robert L.Norton “Machine Design”, Pearson, Fifth edition, 2017.

CO-PO MAPPING

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	2	1										1	3	2
CO2	3	2	1										1	3	2
CO3	3	2	1										1	3	2
CO4	3	2	1										1	3	2