# ACHARYA NAGARJUNA UNIVERSITY

AState Government University, Accredited with "A" Grade by NAAC

Nagarjuna Nagar-522 510, Guntur, Andhra Pradesh, India.

## B.Tech. MECHANICAL ENGINEERING

## SYLLABUS

2020 - 2021 onwards

## Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

## PROGRAM CODE:

## ANUCETUG05


ACHARYA NAGARJUNA UNIVERSITY
సత్యం సర్వం ప్రతిష్ఠితమ్

# ABOUT UNIVERSITY

# ACHARYA NAGARJUNA UNIVERSITY (ANU)

**- A Brief Profile**

Acharya Nagarjuna University, a State University established in 1976, has been constantly striving towards achieving progress and expansion during its existence for over four decades, in terms of introducing new courses in the University Colleges, affiliated colleges and professional colleges. Spread over 300 acres of land on the National High Way (NH-16) between Vijayawada and Guntur of Andhra Pradesh, the University is one of the front ranking and fastest expanding Universities in the state of Andhra Pradesh. The University was inaugurated on 11th September, 1976 by the then President of India, Sri Fakruddin Ali Ahmed and celebrated its Silver Jubilee in 2001. The National Assessment and Accreditation Council (NAAC) awarded "A" grade to Acharya Nagarjuna University and also has achieved 108 International ranks, 39 National ranks UI Green Metrics rankings and many more It is named after Acharya Nagarjuna – one of the most brilliant preceptors and philosophers, whose depth of thought, clarity of perception and spiritual insight were such that even after centuries, he is a source of inspiration to a vast number of people in many countries. The University is fortunate to be situated on the very soil where he was born and lived, a soil made more sacred by the aspiration for light and a state of whole someness by generations of students. With campus student strength of over 5000, the University offers instruction for higher learning in 68 UG & PG programs and guidance for the award of M.Phil.and Ph.D. in 48 disciplines spread over six campus colleges and one PG campus at Ongole. It also offers 160 UG programs in 440 affiliated colleges in the regions of Guntur and Prakasam Districts. It has a Centre for Distance Education offering 87 UG & PG programs. Characterized by its heterogeneous students and faculty hailing from different parts of the state and the country, the University provides most hospitable environment for pursuing Higher Learning and Research. Its aim is to remain connected academically at the forefront of all higher educational institutions. The University provides an excellent infrastructure and on- Campus facilities such as University Library with over one lakh books & 350 journals; Computer Centre; University Scientific Instrumentation Centre; Central Research Laboratory with Ultra-modern Equipment; Well-equipped Departmental Laboratories; Career Guidance and Placement Cell; Health Centre; Sports Facilities with Indoor & Outdoor Stadiums and Multipurpose Gym; Sports Hostel; Separate hostels for Boys, Girls, Research Scholars and International Students; Pariksha Bhavan (Examinations Building); Computers to all faculty members; Wi-Fi connectivity to all Departments and Hostels; Canteen, Student Centre & Fast-food Centre; Faculty Club; Dr. H.H. Deichmann& Dr. S.John David Auditorium cum Seminar Hall; Post office; Telecom Centre; State Bank of India; Andhra Bank; Energy Park; Silver Jubilee Park; Fish ponds; internet center; xerox center; cooperative stores; Water harvesting structures.

# VISION, MISSION & OBJECTIVES OF THE UNIVERSITY

# ACHARYA NAGARJUNA UNIVERSITY

## VISION

To generate sources of knowledge that dispels ignorance and establish truth through teaching, learning and research.

## MISSION

To promote a bank of human talent in diversified faculties – Commerce & Management Studies, Education, Engineering & Technology, Humanities, Law, Natural Sciences, Pharmacy, Physical Education & Sports Sciences, Physical Sciences and Social Sciences that would become an investment for a prosperous society.

## OBJECTIVES

- To inspire and encourage all who would seek knowledge through higher education and research.
- To provide quality instruction and research for the advancement of science and technology.
- To promote teaching and research studies in disciplines of societal relevance.
- To bridge the gap between theory and practice of the principles of higher education.
- To develop human talent necessary for the industry.
- To open up avenues of higher education and research through non-formal means.
- To invite and implement collaborations with other institutes of higher learning on a continuous basis for mutual academic progress.
- To motivate and orient each academic department/centre to strive for and to sustain advanced levels of teaching and research so that the university emerges as an ideal institute of higher learning.
- To focus specially on the studies involving rural economy, justifying its existence in the rural setting.

# VISION

# &

# MISSION OF THE COLLEGE

# ACHARYA NAGARJUNA UNIVERSITY

## Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

## VISION OF THE COLLEGE:

ANU College of Engineering & Technology is started with an aim of imparting technical values in the students, who can change the shape of global scenario in engineering arena.

## MISSION OF THE COLLEGE:

To educate students for careers of leadership, innovation in engineering and its related fields. To expand the base of engineering knowledge through original research and by developing technology to serve the needs of society.

# VISION & MISSION OF THE DEPARTMENT

# ACHARYA NAGARJUNA UNIVERSITY

## Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

## DEPARTMENT OF MECHANICAL ENGINEERING

## B.Tech. MECHANICAL ENGINEERING

### VISION

To be a leading Mechanical Engineering department that fosters excellence in education, research, and innovation, preparing students to become globally competitive engineers and problem solvers.

### MISSION

To provide high-quality education and training in Mechanical Engineering, emphasizing strong theoretical foundations, technical skills, and professional ethics. Foster a culture of research and innovation to address real-world challenges, promote industry collaboration, and prepare students to become globally competitive Engineers. Develop well-rounded professionals with critical thinking, problem-solving abilities, effective communication, and a commitment to lifelong learning. Serve the community by leveraging technological advancements and research-based solutions to contribute to the betterment of society.

# ACHARYA NAGARJUNA UNIVERSITY

## Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

## DEPARTMENT OF MECHANICAL ENGINEERING

## B.Tech. MECHANICAL ENGINEERING

### PROGRAMME EDUCATIONAL OBJECTIVES (PEO'S):

PEO-1: To provide a quality education for students of the Mechanical Engineering profession with a strong background.

PEO-2: To equip students with Robotics, Mechatronics, FEM, CFD, and Dassault 3D experience technologies for deliberating engineering solutions to complex problems.

PEO-3: To promote research leading to innovation, incubation, entrepreneurship & patenting of research outcomes for stakeholders.

PEO- 4: To publish technical information through scholarly publication, conferences and continuing education.

PEO-5: To acquire knowledge of relevant technologies in the multidisciplinary field of social engineering.

### PROGRAMME OUTCOMES (PO's):

Engineering Graduates will be able to:

1) Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2) Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3) Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4) Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5) Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6) The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7) Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8) Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9) Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10) Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11) Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12) Life-long learning: Recognize the need for, and have the preparation and ability to engage in inent and life-long learning in the broadest context of technological change.

## PROGRAMME SPECIFIC OUTCOMES (PSO's):

PSO 1: Graduate engineers will be equipped with all the basic principles of Mechanical Engineering.

PSO 2: Apply Engineering knowledge, analysis, and design tools to solve problems in the domains of Thermal, Manufacturing, and Design.

PSO 3: Engage professionally in industries or as an entrepreneur by applying Manufacturing, Industrial Engineering, and Management practices.

# ACHARYA NAGARJUNA UNIVERSITY

# FACULTY OF ENGINEERING

# ACADEMIC REGULATIONS 2020 (R20) FOR B.TECH (REGULAR)

# (APPLICABLE FOR THE STUDENTS ADMITTED DURING THEACADEMIC YEAR 2020-2021 AND ONWARDS)

## 1. ELIGIBILITY FOR ADMISSION:

Admission to the above program shall be made subject to the eligibility, qualification and specialization prescribed by the University for each program from time to time.

Admission shall be made either on the basis of merit/rank obtained by the qualifying candidates in EAMCET/ECET or otherwise specified, whichever is relevant.

The duration of B.Tech. program is of four academic years divided into eight semesters comprising of two semesters in each academic year. A student is required to choose a branch of study at the time of admission. Students under lateral entry will be admitted straightaway into Third semester of B.Tech. course in the respective branch. No change of branch shall be allowed after the admissions are closed.

## 2. 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) Regular entry students shall pursue a course of study for not less than four academic years and in not more than eight academic years.

ii) Students who fail to fulfill all the academic requirements for the award of the degree within eight academic years (for Regular Entry) / six academic years (for Lateral Entry) from the year of their admission, shall forfeit their seat in B.Tech. course and their admission is cancelled.

Completing the course of study shall mean not only satisfying the attendance requirements but also passing of all the subjects within the respective stipulated period.

## 3. BRANCHES OF STUDY:

The following Branches of study are offered at present for B. Tech. degree

| S.No. | Branch |
|---|---|
| 1 | Civil Engineering |
| 2 | Electrical and Electronics Engineering |
| 3 | Mechanical Engineering |
| 4 | Electronics and Communication Engineering |
| 5 | Computer Science and Engineering |

and any other branch as approved by the authorities of the University from time to time.

Each Branch will have a curriculum with a syllabus that shall consist of the following:

i) General Core Courses
   a) Basic Sciences
   b) Engineering Sciences
   c) Humanities and social sciences
ii) Program core courses in Engineering / Technology
iii) Elective courses of Engineering / Technology / Management Entrepreneurship / Business Communication and allied fields.
iv) Open Electives/CBCS
v) Mandatory learning courses
vi) Project work

## 4. CREDITS:

i) Academic Year: Two consecutive (one odd + one even) semesters constitute one academic year.
ii) Choice Based Credit System (CBCS): The CBCS provides choice for students to select from the prescribed courses (core, elective or minor or soft skill courses).
iii) Credit: A unit by which the course work is measured.

## 5. DISTRIBUTION AND WEIGHTAGE OF MARKS (INTERNAL & EXTERNAL):

i) 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 internship Project work shall be evaluated for 100 and 200 marks respectively.
ii) For both theory and lab subjects the distribution shall be 30 marks for Internal Evaluation and 70 marks for the External Evaluation.
iii) There shall be five units in each of the theory subjects.
iv) For theory subjects, there shall be two midterm examinations during the semester. Each midterm examination shall consist of assignment for 10 marks and sessional test for 20 marks with duration of 135 minutes respectively.

   First midterm examination shall be conducted for 50% coverage of syllabus and second midterm examination shall be conducted for remaining 50% of syllabus. Both the midterm exams are compulsory. Final midterm examination marks for a total of 30 marks shall be arrived at, by considering the 80% weightage (24 marks) to that midterm examination in which the student scores more marks and the remaining 20% (6 marks) for other midterm exam.

   *Note 1: The assignment test paper shall contain 6 questions of equal weightage and student is asked to answer any 2 questions randomly and shall be condensed for 10 marks, any fraction rounded off to the next higher mark.

*Note 2: The sessional examination shall contain 3 questions out of which first question is objective(6marks) and compulsory and remaining two questions(7 marks each) having internal choice and shall be considered for 20 marks, any fraction rounded off to the next higher mark.

v) For theory subjects, there will be 5 questions with following pattern in the End-Examination.

a) All Questions have to be answered compulsorily.

b) All five questions, EITHER/OR type shall be followed with 12 marks for each.

c) In each question as mentioned in (c), one, two or more bits can be set.

vi) Further, whenever any theory subject with two parts is offered (combined subject), for ex: Electrical & Mechanical Technology, then there shall be only two parts Part A, Part B in the question paper.

First question objective can be equally divided into two parts.

Part – A: shall contain two questions, EITHER/OR type shall be followed with 12 marks for each.

Part – B: shall also contain two questions, EITHER/OR type shall be followed with 12 marks for each.

vii) Model Question paper for each theory course shall be prepared by the teacher within 15 days from the commencement of the semester and the same shall be forwarded to the Controller of Examinations through the Chairman, BOS concerned.

viii) For practical subjects there shall be a continuous evaluation during the semester for 30 internal marks and 70 end examination marks. Day-to-day work in the laboratory shall be evaluated for 15 marks by the concerned laboratory teacher based on the report of experiments/jobs (10 marks for the record submitted and 5 marks for day to day work). The end examination for 15 marks (10 marks for experiment and 5 marks for viva-voce) shall be conducted by the laboratory teacher and another examiner from the same department.

*Note: Day to day performance shall be recorded in student record (each experiment carries 15 marks, at least ten experiments should be done and average marks must be taken at the end of semester).

ix) For the subject having design and / or drawing, such as Engineering Drawing, Machine Drawing and Estimation, the distribution shall be 30 marks for internal evaluation and 70 marks for end examination. The Internal evaluation will be 20 marks for day-to-day work in the class that shall be evaluated by the concerned subject teacher based on the reports/submissions prepared in the class. Further, there shall be two midterm exams in a Semester for a duration of 2 hrs. Each evenly distributed over the syllabi for 20 marks and the average marks of both the mid examinations shall be considered as internal test marks. The sum of day-to-day evaluation and the internal test marks will be the final internal marks for the subject.

x) Out of a total of 150 marks for the project work, 50 marks shall be for Internal Evaluation and 100 marks for the End Semester Examination (Viva-voce). The viva-voce shall be conducted by a committee consisting of Head of the Department, Project Supervisor and an External Examiner nominated by the principal from the panel of 3 members proposed by Head of the Department. The project work shall start in IV-year II semester. The evaluation of project work shall be conducted at the end of the IV-year II semester. The Internal Evaluation shall be made on the basis of weekly progress (a minimum of 12 weeks and 3 marks for each week progress) and at least two seminars (one at the beginning of IV B.Tech. II semester (30 marks) and the other before submission of project work (20 marks) given by each student on the topic of his project.

xi) The laboratory records and internal test papers shall be preserved for minimum of 2 years in the respective departments and shall be produced to the Committees of the college as and when the same are asked for.

xii) A student shall be permitted to pursue up to a maximum of ONE elective courses under MOOCs during the Program. The courses must be of minimum 12 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to pursue and acquire a certificate for a MOOC course only from the organizations/agencies approved by the BoS in order to earn the 2 credits. The Head of the department shall notify the list of such courses at the beginning of the semester.

## 6. ATTENDANCE REQUIREMENTS:

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

ii) Shortage of Attendance below 65% in aggregate shall in NO case be condoned.

iii) Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the College Academic Committee.

iv) 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.

v) A student will not be promoted to the next semester unless he satisfies the attendance requirements of the present semester, as applicable. They may seek readmission for that semester when offered next.

vi) A stipulated fee shall be payable towards condonation of shortage of attendance to the college.

## 7. MINIMUM ACADEMIC REQUIREMENTS (FOR REGULAR ENTRY STUDENTS):

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.6

i) A student who could not secure a minimum of 50% aggregate from midterm examination marks is not eligible to appear for the semester end examination and shall have to repeat that semester.

ii) A student shall be deemed to have satisfied the minimum academic requirements and earned the credits allotted to each theory, design, drawing subject or project if he secures not less than 40% of marks in the end examination and a minimum of 50% of marks in the sum total of the internal evaluation and end examination taken together. In the internship & project he/she should secure 40%. For practical examination if he secures not less than 50% of marks in the semester end examination.

iii) A student shall be promoted from I to II year only if he/she fulfils the academic requirements of attendance and internal marks as stipulated in clause 6 and 7 irrespective of back log subjects in I/IV B.Tech.

iv) A student shall be promoted from II to III year only if he/she fulfils the academic requirements of attendance and internal marks as stipulated in clause 6 and 7 and also must secure 70% of the credits of the subjects that have been studied up to I year II semester from irrespective of whether the candidate takes the end examination or not as per the normal course of study. At the time of commencement of class work, he must attain the re quired credits.

v) A student shall be promoted from third year to fourth year only if he fulfills the academic requirements of attendance and internal marks as stipulated in clause 6 and 7 and also must secure 70% of the credits of the subjects that have been studied up to II-year II semester. At the time of commencement of class work, he must attain the required credits

And in case of getting detained for want of credits by sections ii and iii above, the student may make up the credits through supplementary exams of the above exams before the date of class work commencement of Third or Fourth year I semester respectively.

## 8. MINIMUM ACADEMIC REQUIREMENTS (FOR LATERAL ENTRY STUDENTS):

The following academic requirements have to be satisfied in addition to the attendance requirements mentioned in item no.6

i) 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 secures not less than 40% of marks in the end examination and a minimum of 50% of marks in the sum total of the internal evaluation and end examination taken together. In the Seminar & Comprehensive viva-voce he/she should secure 40%.

ii) A student who could not secure a minimum of 50% aggregate from midterm examination marks is not eligible to appear for the semester end examination and shall have to repeat that semester.

iii) A student shall be promoted from II to III year only if he/she fulfils the academic requirements of attendance and internal marks as stipulated in clause 6 and 7 irrespective of back log subjects in II/IV B.Tech.

iv) A student shall be promoted from III to IV year only if he/she fulfils the academic requirement of attendance and internal marks as stipulated in clause 6 and 7 and also must secure 70% of the subjects that have been studied up to III year I semester from

## 9. 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 | O (Outstanding) | 10 |
| 80-89 | A+ (Excellent) | 9 |
| 70-79 | A (Very Good) | 8 |
| 60-69 | B+ (Good) | 7 |
| 50-59 | B (Above Average) | 6 |
| 45-49 | C (Average) | 5 |
| 40-44 | D (Pass) | 4 |
| < 40 | F (Fail) | 0 |
| Absent | Ab (Absent) | 0 |

i) A student obtaining Grade F shall be considered failed and will be required to reappear for that subject when the next supplementary examination offered.

ii) For non credit courses ‘Satisfactory’ or “Unsatisfactory’ shall be indicated instead of the letter grade and this will not be counted for the computation of SGPA/CGPA.

## 9.1. SEMESTER GRADE POINT AVERAGE (SGPA) AND CUMULATIVE GRADE POINT AVERAGE (CGPA):

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

$$SGPA = \Sigma (Ci \times Gi) / \Sigma Ci$$

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

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

$$CGPA = \Sigma (Ci \times Si) / \Sigma Ci$$

Where 'Si' is the SGPA of the ith semester and Ci 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 GPA/CGPA the subjects in which the student is awarded Zero grade points will also be included.

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

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

## 10. GAP - YEAR:

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

## 11. TRANSITORY REGULATIONS: (OLD REGULATIONS CHANGED)

i) Candidates who admitted into the four year B.Tech. degree course under R-15 regulations but who got detained in any year for want of attendance/minimum aggregate sessional marks may join the appropriate year /semester in the semester system applicable for that batch and be governed by the regulations of that batch from then onwards unless otherwise specified.

ii) A student admitted under credit-based regulations (CR) detained due to lack of sessional marks/attendance at the end of the first semester of II/IV B.Tech. shall join II/IV first semester of R-15 batch. Such students will study all the courses prescribed for that R-15 in which the student joins. However, the student has to clear all the first-year backlog subjects by appearing the supplementary examination. Such candidates will be governed by the regulations applicable to lateral entry candidates of R-15 batch for the award of the degree.

iii) A student admitted under CR, detained due to lack of sessional marks / attendance at the end of the second semester of II/IV B.Tech. /at the end of subsequent semesters shall follow the credit-based regulations only (CR).

## 12. WITH–HOLDING OF RESULTS:

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

## 13. 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 shall be placed in one of the following four classes:

| Class Awarded | CGPA Secured |
|---|---|
| First Class with Distinction | $\geq 8.0$ |
| First Class | $\geq 6.5 < 8.0$ |
| Second Class | $\geq 5.5 < 6.5$ |
| Pass Class | $\geq 4.0 < 5.5$ |

## 14. MINIMUM INSTRUCTION DAYS:

The minimum instruction period for a semester is 16 weeks. The minimum instruction days including exams for each semester shall be for 90 days.

## 15. BRANCH TRANSFER:

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

## 16. GENERAL:

i) The academic regulations should be read as a whole for purpose of any interpretation.

ii) Malpractice rules - nature and punishments is appended

iii) Where the words "he", "him", "his", occur in the regulations, they include "she", "her", "hers".
iv) In the case of any doubt or ambiguity in the interpretation of the above rules, the decision of the BOS is final.
v) The University may from time to time, revise, amend or change the Regulations, Schemes of Examinations, and/or Syllabi.

## 17. CONDUCT AND DISCIPLINE:

a) Students shall conduct themselves within and outside the premises of the institute in a manner befitting the students of our institution.
b) As per the order of Honorable Supreme Court of India, ragging in any form is considered as a criminal offence and is banned. Any form of ragging will be severely dealt with.
c) The following acts of omission and / or commission shall constitute gross violation of the code of conduct and are liable to invoke disciplinary measures with regard to ragging.
   i) Lack of courtesy and decorum, indecent behavior anywhere within or outside the campus.
   ii) Will full damage of college / individual property
   iii) Possession, consumption or distribution of alcoholic drinks or any kind of narcotics or hallucinogenic drugs.
   iv) Mutilation or unauthorized possession of library books.
   v) Noisy and unseemly behavior, disturbing studies of fellow students.
   vi) Hacking of computer systems (such as entering into other person's areas without prior permission, manipulation and / or damage of computer hardware and software or any other cyber-crime etc.)
   vii) Usage of camera / cell phone in the campus
   viii) Plagiarism of any nature
   ix) Any other acts of gross indiscipline as decided by the academic council from time to time.
d) Commensurate with the gravity of offense, the punishment may be reprimand, fine, expulsion from the institute / hostel, debar from examination, disallowing the use of certain facilities of the institute, rustication for a specified period or even outright expulsion from the institute or even handing over the case to appropriate law enforcement or the judiciary, as required by the circumstances.
e) For an offence committed in (i) a hostel (ii) a department or in a class room and (iii) elsewhere, the chief warden, the head of the department and the principal respectively, shall have the authority to reprimand or impose fine.
f) Cases of adoption of unfair means and / or any malpractice in an examination shall be reported to the principal for taking appropriate action.
g) All cases of serious offence, possibly requiring punishment other than reprimand, shall be reported to the academic council.
h) The institute level standing disciplinary action committee constituted by the academic council shall be the authority to investigate the details of the offence, and recommend disciplinary action based on the nature and extent of the offence committed.

i) The principal shall deal with any academic problem, which is not covered under these rules and regulations, in consultation with the programs committee in an appropriate manner, and subsequently such actions shall be placed before the academic council for ratification. Any emergency modification of regulation, approved by the appropriate authority, shall be reported to the academic council for ratification.

j) "Grievance and Redressal Committee" (General) constituted by the Principal shall deal with all grievances pertaining to the academic / administrative / disciplinary matters.

## 18. 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 Malpractices/Improper conduct | Punishment |
|---|---|---|
| 1. | Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the student which can be used as an aid in the subject of the examination) | Expulsion from the examination hall and cancellation of the performance in that subject only. |
| 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 subject. |
| 3 | Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny. | Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester / year examinations. |
| 4 | Gives assistance or guidance or receives it from any other student orally or by any other body language methods or communicates through cell phones with any other student or persons in or outside the exam hall in respect of any matter. | Expulsion from the examination hall and cancellation of the performance in that subject only of all the students involved. In case of an outsider, he will be handed over to the p is registered against him olice and a case |

| | | |
|---|---|---|
| 5 | Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the student is appearing. | Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects 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 subject and all other subjects 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 subject and all the other subjects 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 forfeiture of seat. |
| 8 | Refuses to obey the orders of the Chief Superintendent / Assistant Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer-in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination. | In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects of that semester / year. The students also are debarred and forfeit their seats. In case of outsiders, they will be handed over tothe police and a police case is registered against them. |

| | | |
|---|---|---|
| 9 | Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall. | Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects including practical examinations and project work of that semester/year. The candidate is also debarred for two consecutive semesters from class work and all University 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 subject and all other subjects 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 clause 7 to 9. | For Student of the college: Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects including practical examinations and project work of that semester/year. The candidate is also debarred and forfeits the seat.<br>Person(s) who do not belong to the College will be handed over to police and, a police case will 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 fur 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 is registered against him. |

| | | |
|---|---|---|
| | | The performance of the original student who has been impersonated, shall be cancelled in all the subjects of the examination including practical's 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 clauses 1 to 12 it shall be reported to the college academic council for further action to 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. | |

## CURRICULAR FRAMEWORK FOR REGULAR AND HONORS B.TECH. PROGRAMS OF ALL BRANCHES:

### AWARD OF THE DEGREE:

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

i) Pursues a course of study in not less than four and not more than eight academic years.
ii) After eight academic years from the year of their admission, he/she shall forfeit their seat in B. Tech course and their admission stands cancelled.
iii) Registers for 160 credits and must secure all the 160 credits.
iv) A student shall be eligible for the award of B.Tech. degree with Honors or Minor if he/she earns 20 credits in addition to the 160 credits. A student shall be permitted to register either for Honors or for Minor and not for both simultaneously.

### CURRICULAR FRAMEWORK FOR HONORS PROGRAM:

1) Students of a Department/Discipline are eligible to opt for Honors Program offered by the same Department/Discipline.
2) A student shall be permitted to register for Honors program at the beginning of 4th semester provided that the student must have acquired a minimum of 8.0 SGPA up to the end of 2nd semester without any backlogs. In case of the declaration of the 3rd semester results after the commencement of the 4th semester and if a student fails to score the required minimum of 8 SGPA, his/her registration for Honors Program stands cancelled and he/she shall continue with the regular Program.
3) Students can select the additional and advanced courses from their respective branch in which they are pursuing the degree and get an honors degree in the same. e.g. If a Mechanical Engineering student completes the selected advanced courses from same branch under this scheme, he/she will be awarded B.Tech. (Honors) in Mechanical Engineering.
4) In addition to fulfilling all the requisites of a Regular B.Tech. Program, a student shall earn 20 additional credits to be eligible for the award of B. Tech (Honors) degree. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e., 160 credits).
5) Of the 20 additional Credits to be acquired, 16 credits shall be earned by undergoing specified courses listed as pools, with four courses, each carrying 4 credits. The remaining 4 credits must be acquired through two MOOCs, which shall be domain specific, each with 2 credits and with a minimum duration of 8/12weeks as recommended by the Board of studies.
6) It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. The courses offered in each pool shall be domain specific courses and advanced courses.
7) The concerned 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.

8) 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)
9) 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 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned will be as decided by the university/academic council.
10) 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 Program.
11) 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.
12) 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.
13) Honors must be completed simultaneously with a major degree program. A student cannot earn Honors after he/she has already earned bachelor's degree.

## CURRICULAR FRAMEWORK FOR MINOR PROGRAM:

1) a) Students who are desirous of pursuing their special interest areas other than the chosen discipline of Engineering may opt for additional courses in minor specialization groups offered by a department other than their parent department. For example, If Mechanical Engineering student selects subjects from Civil Engineering under this scheme, he/she will get Major degree of Mechanical Engineering with minor degree of Civil Engineering
   b) Student can also opt for Industry relevant tracks of any branch to obtain the Minor Degree, for example, a B.Tech. Mechanical student can opt for the industry relevant tracks like Data Mining track, IOT track, Machine learning track etc.
2) The BOS concerned shall identify as many tracks as possible in the areas of emerging technologies and industrial relevance / demand. For example, the minor tracks can be the fundamental courses in CSE, ECE, EEE, CE, ME etc or industry tracks such as Artificial Intelligence (AI), Machine Learning (ML), Data Science (DS), Robotics, Electric vehicles, Robotics, VLSI etc.

3) The list of disciplines/branches eligible to opt for a particular industry relevant minor specialization shall be clearly mentioned by the respective BoS.
4) There shall be no limit on the number of programs offered under Minor. The 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.
5) The concerned BoS shall decide on the minimum enrolments for offering Minor program by the department. If a minimum enrolments criterion is not met, then the students may be permitted to register for the equivalent MOOC courses as approved by the concerned Head of the department in consultation with BoS.
6) A student shall be permitted to register for Minors program at the beginning of 4th semester subject to a maximum of two additional courses per semester, provided that the student must have acquired 8 SGPA (Semester Grade point average) up to the end of 2nd semester without any history of backlogs. It is expected that the 3rd semester results may be announced after the commencement of the 4th semester. If a student fails to acquire 8 SGPA up to 3rd 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. 18
7) A student shall earn additional 20 credits in the specified area to be eligible for the award of B. Tech degree with Minor. This is in addition to the credits essential for obtaining the Under Graduate Degree in Major Discipline (i.e., 160 credits).
8) Out of the 20 Credits, 16 credits shall be earned by undergoing specified courses listed by the concerned BoS along with prerequisites. It is the responsibility of the student to acquire/complete prerequisite before taking the respective course. If a course comes with a lab component, that component has to be cleared separately. A student shall be permitted to choose only those courses that he/she has not studied in any form during the Program.
9) In addition to the 16 credits, students must pursue at least 2 courses through MOOCs. The courses must be of minimum 8 weeks in duration. Attendance will not be monitored for MOOC courses. Student has to acquire a certificate from the agencies approved by the BOS with grading or marks or pass/fail in order to earn 4 credits. If the MOOC course is a pass/fail course without any grades, the grade to be assigned as decided by the university/academic council.
10) 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.

11) 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.
12) If a student drops (or terminated) from the Minor program, they cannot convert the earned credits into free or core electives; they will remain extra. These additional courses will find mention in the transcript (but not in the degree certificate). In such cases, the student may choose between the actual grade or a "pass (P)" grade and also choose to omit the mention of the course as for the following: All the courses done under the dropped Minors will be shown in the transcript. None of the courses done under the dropped Minor will be shown in the transcript. 19
13) 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.
14) Minor must be completed simultaneously with a major degree program. A student cannot earn the Minor after he/she has already earned bachelor's degree.

## INDUSTRIAL COLLABORATIONS (CASE STUDY)

★ University-Industry linkages refer to the interaction between firms and universities or public research centers with the goal of solving technical problems, working on R&D, innovation projects and gathering scientific as well as technological knowledge. It involves the collaboration of Industries and Universities in various areas that would foster the research ecosystem in the country and enhance growth of economy, industry and society at large.

★ The Universities/Institutions (Autonomous) are permitted to design any number of Industry oriented minor tracks as the respective BoS feels necessary. In this process the Universities/Institutions can plan to have industrial collaborations in designing the minor tracks and to develop the content and certificate programs. Industry giants such as IBM, TCS, WIPRO etc., may be contacted to develop such collaborations. The Universities/Institutions shall also explore the possibilities of collaborations with major Industries in the core sectors and professional bodies to create specialized domain skills.

# STRUCTURE

# ACHARYA NAGARJUNA UNIVERSITY

## Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

## DEPARTMENT OF MECHANICAL ENGINEERING

## B.TECH. MECHANICAL ENGINEERING

## COURSE STRUCTURE (R20)

### I/IV B. TECH - SEMESTER-I

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **ME111 (R20)** | Mathematics - I | BS | 3 | 1 | 0 | 30 | 70 | 3 |
| 2 | **ME112 (R20)** | Engineering Chemistry | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 3 | **ME113 (R20)** | Basic Electrical Engineering | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 4 | **ME114 (R20)** | Engineering Graphics | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 5 | **ME115 (R20)** | Computer Programming With C | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 6 | **ME151 (R20)** | Mechanical Work Shop | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 7 | **ME152 (R20)** | Engineering Chemistry Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 8 | **ME153 (R20)** | Computer Programming Using C Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| **TOTAL CREDITS** | | | | | | | | | **19.5** |

# I/IV B. TECH - SEMESTER-II

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **ME121 (R20)** | Mathematics - II | BS | 3 | 1 | 0 | 30 | 70 | 3 |
| 2 | **ME122 (R20)** | Engineering Physics | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 3 | **ME123 (R20)** | Professional Communication Skills | PC | 3 | 0 | 0 | 30 | 70 | 3 |
| 4 | **ME124 (R20)** | Python Programming | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 5 | **ME125 (R20)** | Engineering Mechanics | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 6 | **ME126 (R20)** | Environmental Science (Mandatory) | MC | 3 | 0 | 0 | 30 | 70 | 0 |
| 7 | **ME161 (R20)** | Engineering Physics Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 8 | **ME162 (R20)** | Communication Skills Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 9 | **ME163 (R20)** | Python Programming Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| **TOTAL CREDITS** | | | | | | | | | **19.5** |

# II/IV B. TECH SEMESTER-I

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **ME211 (R20)** | Engineering Mathematics-III (Probability and Statistics) | BS | 3 | 1 | 0 | 30 | 70 | 3 |
| 2 | **ME212 (R20)** | Strength of Materials-I | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 3 | **ME213 (R20)** | Material Science and Metallurgy | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 4 | **ME214 (R20)** | Basic Thermodynamics | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 5 | **ME215 (R20)** | Manufacturing Process | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 6 | **ME216 (R20)** | Constitution of India | MC | 3 | 0 | 0 | 30 | 70 | 0 |
| 6 | **ME251 (R20)** | Machine Drawing Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 7 | **ME252 (R20)** | Manufacturing Process Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 8 | **ME253 (R20)** | Strength of Materials Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 9 | **ME254 (R20)** | CATIA-2D Drafting | Skill Course | 0 | 0 | 3 | 30 | 70 | 2 |
| **TOTAL CREDITS** | | | | | | | | | **21.5** |

# II/IV B. TECH - SEMESTER-I

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **ME221 (R20)** | Strength of Materials-II | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 2 | **ME222 (R20)** | Kinematics of Machines | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 3 | **ME223 (R20)** | Fluid Mechanics & Hydraulic Machines | ESC | 3 | 1 | 0 | 30 | 70 | 3 |
| 4 | **ME224 (R20)** | Applied Thermodynamics | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 5 | **ME225 (R20)** | Professional Ethics And Human Values | BSC | 3 | 0 | 0 | 30 | 70 | 3 |
| 7 | **ME261 (R20)** | Fluid Mechanics & Hydraulic Machines Lab | ESC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 8 | **ME262 (R20)** | Modeling Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 9 | **ME263 (R20)** | Advanced English Communication Skills Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 10 | **ME264 (R20)** | Matlab for Mechanical Engineering | Skill Course | 0 | 0 | 3 | 30 | 70 | 2 |
| **TOTAL CREDITS** | | | | | | | | | **21.5** |

# III/IV B. TECH -SEMESTER-I

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **ME311 (R20)** | Design of Machine Elements | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 2 | **ME312 (R20)** | Dynamics of Machines | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 3 | **ME313 (R20)** | Metal cutting & Machine Tools | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 4 | **ME314 (R20)** | Job Oriented Elective-I | OE/JOE | 3 | 1 | 0 | 30 | 70 | 3 |
| 5 | **ME315 (R20)** | Professional Elective-I | PE | 3 | 1 | 0 | 30 | 70 | 3 |
| 6 | **ME316 (R20)** | Fundamentals of Research Methodology | MC | 3 | 0 | 0 | 30 | 70 | 0 |
| 7 | **ME351 (R20)** | Machine Shop Practice Laboratory | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 8 | **ME352 (R20)** | Fuels & I.C Engines Laboratory | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 9 | **ME353 (R20)** | Soft Skills Lab | Skill Course | 0 | 0 | 3 | 30 | 70 | 2 |
| 10 | **ME354 (R20)** | Summer Internship 2 Months after second year (to be evaluated during V semester) | MC | 0 | 0 | 3 | 100 | 0 | 1.5 |
| **TOTAL CREDITS** | | | | | | | | | **21.5** |

**JOB ORIENTED ELECTIVE-I**

a) I.C Engines & Gas Turbines
b) Elements of Aerospace Engineering
c) Computational Fluid Dynamics

**PROFESSIONAL ELECTIVE-I**

a) Operations Research
b) Process Planning and Cost Estimation
c) Total Quality Management

# III/IV B. TECH SEMESTER-II

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | Int. | Ext. | Int. | Ext. | |
| 1 | **ME321 (R20)** | Design of Transmission Elements | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 2 | **ME322 (R20)** | Heat Transfer | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 3 | **ME323 (R20)** | Advanced Manufacturing Engineering | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 4 | **ME324 (R20)** | Job Oriented Elective-II | OE/JOE | 3 | 1 | 0 | 30 | 70 | 3 |
| 5 | **ME325 (R20)** | Professional Elective-II | PE | 3 | 1 | 0 | 30 | 70 | 3 |
| 6 | **ME326 (R20)** | Design thinking for innovation | MC | 3 | 0 | 0 | 30 | 70 | 0 |
| 7 | **ME361 (R20)** | Computer Applications in Mechanical Engineering Laboratory | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 8 | **ME362 (R20)** | Design & Metrology Lab | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 9 | **ME363 (R20)** | Heat Transfer Laboratory | PC | 0 | 0 | 3 | 30 | 70 | 1.5 |
| 10 | **ME364 (R20)** | Delmia & Simulia Lab | Skill Course | 0 | 0 | 3 | 30 | 70 | 2 |
| **TOTAL CREDITS** | | | | | | | | | **21.5** |

**JOB ORIENTED ELECTIVE-II**

a) Industrial Engineering & Management.
b) Production Planning and Control
c) Product Lifecycle Management

**PROFESSIONAL ELECTIVE-II**

a) Mechanical Measurements & Metrology
b) Composite Materials
c) Farm Machinery and Equipment

# IV/IV B. TECH - SEMESTER-I

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **ME411 (R20)** | Advanced Machine Design | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 2 | **ME412 (R20)** | Automation & Computer Aided Manufacturing | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 3 | **ME413 (R20)** | Finite Element Methods | PC | 3 | 1 | 0 | 30 | 70 | 3 |
| 4 | **ME414 (R20)** | Program Elective-III | PE | 3 | 1 | 0 | 30 | 70 | 3 |
| 5 | **ME415 (R20)** | MOOCS | OE/JOE | 3 | 1 | 0 | 0 | 100 | 3 |
| 6 | **ME416 (R20)** | Energy Recourses & Utilization | BS | 3 | 0 | 0 | 30 | 70 | 3 |
| 7 | **ME451 (R20)** | Computer Aided Manufacturing Lab | Skill Oriented Course | 0 | 0 | 3 | 30 | 70 | 2 |
| 8 | **ME452 (R20)** | Industrial/ Research Internship (2 Months) | MC | 0 | 0 | 3 | 100 | 0 | 3 |
| **TOTAL CREDITS** | | | | | | | | | **23** |

## PROGRAM ELECTIVE COURSE-III

a) Refrigeration & Air conditioning
b) Automobile Engineering
c) Computer Graphics

## OPEN ELECTIVE (OE) / JOB ORIENTED ELECTIVE-III

a) Operations Research
b) Robotics
c) Fluid Power & Control systems

# IV/IV B. TECH -SEMESTER-II

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **ME461 (R20)** | Project Work | Project | 0 | 0 | 6 | 50 | 100 | 8 |
| 2 | **ME462 (R20)** | Seminar | Seminar | 0 | 0 | 0 | 50 | 0 | 2 |
| 3 | **ME463 (R20)** | MOOCs | MOOCs | 0 | 0 | 3 | 100 | 0 | 2 |
| **TOTAL CREDITS** | | | | | | | | | **12** |

# HONOURS DEGREE COURSES [R20]

## POOL I - AUTOMOBILE DOMAIN:

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **MEH101 (R20)** | Modern Vehicle Technology | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 2 | **MEH102 (R20)** | Automobile Engineering | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 3 | **MEH103 (R20)** | Alternative Energy Source for Automobiles | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 4 | **MEH104 (R20)** | Vehicle Body Engineering | Honour | 3 | 0 | 0 | 30 | 70 | 4 |

## POOL II - AUTOMATION DOMAIN:

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **MEH201 (R20)** | Field & Service Robotics | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 2 | **MEH202 (R20)** | Mechatronics | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 3 | **MEH203 (R20)** | Control Systems | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 4 | **MEH204 (R20)** | CAD/CAM | Honour | 3 | 0 | 0 | 30 | 70 | 4 |

## POOL III - THERMAL DOMAIN:

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **MEH301 (R20)** | Computational Fluid Dynamics | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 2 | **MEH302 (R20)** | Gas Dynamics & Jet Propulsion | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 3 | **MEH303 (R20)** | Alternate fuels & Energy Systems | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 4 | **MEH304 (R20)** | Safety Aspects of Nuclear Power Plants | Honour | 3 | 0 | 0 | 30 | 70 | 4 |

## POOL IV - PRODUCTION DOMAIN:

| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
|---|---|---|---|---|---|---|---|---|---|
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **MEH401 (R20)** | Additive Manufacturing | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 2 | **MEH402 (R20)** | Supply Chain Management | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 3 | **MEH403 (R20)** | Flexible Manufacturing Systems | Honour | 3 | 0 | 0 | 30 | 70 | 4 |
| 4 | **MEH404 (R20)** | Rapid Prototyping | Honour | 3 | 0 | 0 | 30 | 70 | 4 |

**NOTE:**

1) Students has to acquire 16 credits with minimum one subject from each pool. (04 courses @ 4 credits each)
2) Compulsory MOOC/NPTEL Courses for 04 credits (02 courses @ 2 credits each)

# MINOR DEGREE COURSES [R20]

| Eligibility: Students of all branches Except Mechanical Engineering | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| S. No. | Course Details | | Category | Scheme of Instruction | | | Scheme of Examination | | |
| | Code | Subject Name | | Hours in a Week | | | Marks | | Credits |
| | | | | L | T | P | Int. | Ext. | |
| 1 | **MEM11 (R20)** | Basic Mechanical Sciences | Minors | 3 | 0 | 0 | 30 | 70 | 4 |
| 2 | **MEM12 (R20)** | Thermal Engineering | Minors | 3 | 0 | 0 | 30 | 70 | 4 |
| 3 | **MEM13 (R20)** | Production Technology | Minors | 3 | 0 | 0 | 30 | 70 | 4 |
| 4 | **MEM14 (R20)** | Fundaments of Engineering Design | Minors | 3 | 0 | 0 | 30 | 70 | 4 |
| 5 | **MEM15 (R20)** | Production Planning & Control | Minors | 3 | 0 | 0 | 30 | 70 | 4 |
| 6 | **MEM16 (R20)** | Metallurgy and Material Science | Minors | 3 | 0 | 0 | 30 | 70 | 4 |

# I/IV B.Tech.
# SEMESTER I

# ACHARYA NAGARJUNA UNIVERSITY

## Dr. Y.S.R. ANU COLLEGE OF ENGINEERING & TECHNOLOGY

## DEPARTMENT OF MECHANICAL ENGINEERING

## B.Tech. MECHANICAL ENGINEERING

## SEMESTER-I

### ME111 (R20): MATHEMATICS-I

### CE/ME/EE/EC/CS 111 (R20)

(Calculus & Algebra)

(Common to all branches of Engineering)

| L-3 | T-0 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

- This course will illuminate the students in the concepts of calculus and linear algebra.
- To equip the students with standard concepts and tools at an intermediate to advanced level mathematics to develop the confidence and ability among the students to handle various real world problems and their applications.

**Bridge Course:** Limits, continuity, Types of matrices

### COURSE OUTCOMES:

After completion of this course, students will be able to –

| | |
|---|---|
| **CO1** | Using Matrix method find the inverse of matrix, and using other methods solving Homogeneous and non-homogeneous equations. Determining the eigen values and eigen vectors. |
| **CO2** | Finding the approximate real root of given equation. |
| **CO3** | Finding partial derivatives of first and higher orders and maxima and minima of functions of two variables. |
| **CO4** | Evaluate double integrals techniques over a region of two dimensional and with polar coordinates. |
| **CO5** | Familiarize with special functions to evaluate some proper and improper integrals using beta and gamma functions. |

**Unit I: Matrix Operations and Solving Systems of Linear Equations**

Rank of a matrix by echelon form, solving system of homogeneous and non-homogeneous equations linear equations. Eigen values and Eigen vectors and their properties, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, diagonalisation of a matrix, quadratic forms and nature of the quadratic forms, reduction of quadratic form to canonical forms by orthogonal transformation.

**Unit II: Mean Value Theorems**

Rolle's Theorem, Lagrange's mean value theorem, Cauchy's mean value theorem, Taylor's and Maclaurin theorems with remainders (without proof);

**Unit III: Multivariable calculus**

Partial derivatives, total derivatives, chain rule, change of variables, Jacobians, maxima and minima of functions of two variables, method of Lagrange multipliers.

**Unit IV: Double Integrals**

Double integrals, change of order of integration, double integration in polar coordinates, areas enclosed by plane curves.

**Unit V: Special Functions**

Beta and Gamma functions and their properties, relation between beta and gamma functions.

## TEXT BOOKS:

1) Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2) B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.

## REFERENCE BOOKS:

1) R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
2) George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
3) Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 201.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 2 | - | - | - | - | - | - | - | 2 | 3 | - | - | - |
| **CO2** | 1 | 3 | - | - | - | - | - | - | - | 1 | 3 | - | - | - |
| **CO3** | 2 | 3 | - | - | - | - | - | - | - | 2 | 2 | - | - | - |
| **CO4** | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | - | - | - |
| **CO5** | 2 | 3 | - | - | - | - | - | - | - | 1 | 3 | - | - | - |
| **AVG_CO** | 2 | 3 | - | - | - | - | - | - | - | 2 | 3 | - | - | - |

# ME112 (R20): ENGINEERING CHEMISTRY

## ME/CE 112 (R20)

| L-3 | T-0 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

- To acquire knowledge about desalination of brackish water and treatment of municipal water.
- To gain the knowledge of conducting polymers, bio-degradable polymers and fibere inforced plastics and the synthesis of nano materials.
- Apply electrochemical basics to the field of battery technology and the main components and chemistries and the manufacturing process of batteries. assess different batteries by teaching them about battery specifications.
- To understand the mechanism of corrosion and preventive methods.
- This subject is designed to impart fundamental knowledge of the principles and instrumentation of spectroscopic and chromatographic techniques.
- The main processes involved during cement production will be discussed, including the extraction and Processing of raw materials, the combustion process, cement grinding, quality control and storage, and cement distribution.
- To understand the nucleophilic substitution and elimination mechanisms.
- The synthesis of aspirin and paracetamol lab methods are used included recrystallization and scratching to produce a precipitate, which was then filtered to remove any excess moisture.

### COURSE OUTCOMES:

After completion of this course, students will be able to –

| | |
|---|---|
| **CO1** | Develop innovative methods to produce soft water for industrial use and potable water at cheaper cost |
| **CO2** | Substitute metals with conducting polymers and also produce cheaper biodegradable polymers to reduce environmental pollution. Design economically and new methods of synthesis nano materials. |
| **CO3** | Identify electronic components that can provide protection and specify a minimum set of protections needed - Compute stored energy in a battery pack - List the manufacturing steps of different types of lithium-ion cells and possible failure modes and apply their knowledge for protection of different metals from corrosion |
| **CO4** | Ability to understand, explain and select instrumental techniques for analysis |

| | |
|---|---|
| **CO5** | Develop the technique involved in the manufacturing process of cement Apply the knowledge about the properties of chemical fuels for the generation of power Apply the knowledge of various polymeric material, their synthesis and applications and synthesize medicinal compounds and the physical chemical properties of drugs using drug design software. |

**UNIT-I: WATER TECHNOLOGY**

Various impurities of Water, WHO guidelines, Hardness unit sand determination by EDTA method, water treatment for drinking purpose-sedimentation, coagulation, filtration (slow sand filter), various methods of chlorination, breakpoint chlorination.

Water treatment for industrial purpose: Boiler troubles, scales, sludges, caustic embrittlement, boiler Corrosion, priming and foaming- causes and prevention, Internal conditioning - Phosphate, Calgon and Carbonate treatment, External conditioning-Lime Soda process (simple problems), softening by ion- Exchange process, Desalination of Brackish water by Electro dialysis and Reverse osmosis.

**UNIT-II: POLYMER CHEMISTRY**

Introduction to polymers, Functionality of monomers, chain growth and step growth polymerization, Co-polymerization (Stereo specific polymerization) with specific examples and mechanisms of polymer formation.

PLASTICS: Thermoplastics and Thermosetting, preparation, properties and applications of Bakelite, Elastomers, Preparation, properties and applications of BUNA-S and BUNA-N Rubbers.

Conducting Polymers- Introduction, examples, general applications and mechanism of Conduction on Polyacetylene.

Chemistry of Nano materials: Introduction to nano chemistry, preparation of nano materials - carbon nanotubes and fullerenes and their engineering applications.

**UNIT-III: ELECTRO CHEMISTRY AND APPLICATIONS**

Electrodes-concepts, types of cells, electro chemical series, Nernst equation.

BATTERIES: Primary cell (Dry cell), Secondary cell (Lead-acid), Lithium batteries and their advantages, Fuel cell ($H_2$-$O_2$ cell).

**Corrosion:**

Types of corrosions- chemical corrosion, dry corrosion, electro chemical corrosion and wet corrosion, galvanic series, pitting and differential aeration of corrosion, factors affecting corrosion.

Corrosion control: Cathodic protection, Corrosion Inhibitors, Electro plating (Au) & (Ni).

**UNIT-IV: INSTRUMENTAL METHODS**

Electromagnetic spectrum-Absorption of Radiation: Beer-Lambert's law-Principle and applications of Ultra-Violet, Infra-Red and Nuclear Magnetic Resonance Spectroscopy. Principle and applications of Gas Chromatography and HPLC Techniques.

**UNIT-V:**

**(i) Cement and Concrete Chemistry**: Introduction to Building Materials, Portland Cement, Constituents, Manufacturing Process, Setting and Hardening Cement.

**(ii) Organic reactions and synthesis of a drug molecule**: Introduction to reactions involving substitution ($SN_1$ and $SN_2$), elimination reactions ($E_1$ and $E_2$), Synthesis of commonly used drug molecule – Aspirin and Paracetmol.

## PRESCRIBED TEXT BOOKS:


1) Engineering Chemistry, P.C. Jain and M. Jain - DhanapathiRai& Sons, Delhi
2) A text book of Engineering Chemistry, S.S. Dara - S. Chand & Co. New Delhi
3) Engineering Chemistry, B.K. Sharma - Krishna Prakashan, Meerut
4) Shashichawla,A text book of engineering chemistry,3rdEdition,Dhanpatrai& co new delhi,2007.
5) Gurudeep raj & chatwalanand , "Instrumental methods of analysis ", 7thedition,CBS publications,1986.
6) Quantitative analysis by day&underwood.
7) A Text book of Instrumental methods by Skoog and West.
8) H.W. Wilard and demerit, "Instrumental methods of analysis ", 7thedition,CBS publications,1986.
9) Text book of Nano Science and Nano technology, B.S. Murthy and P. Shankar, University


## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 1 | - | 1 | 2 | - | - | 1 | - | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 1 | 1 | - | - | 2 | - | - | 1 | - | 3 | 2 | 2 |
| **CO3** | 3 | 2 | 1 | 2 | 1 | - | - | - | - | 1 | - | 3 | 2 | 2 |
| **CO4** | 3 | 3 | 2 | 1 | 1 | - | - | - | - | 1 | - | 2 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 2 | - | 1 | - | - | - | 1 | - | 3 | 3 | 2 |
| **AVG_CO** | **3** | **3** | **2** | **1** | **1** | **1** | **2** | **-** | **-** | **1** | **-** | **3** | **3** | **3** |

# ME113 (R20): BASIC ELECTRICAL ENGINEERING

## CE/ME/CS 113 (R20)

| L-3 | T-1 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OUTCOMES:

After completion of this course, students will be able to

| | |
|---|---|
| **CO1** | Understand the fundamental concepts of DC and AC circuits, including Kirchhoff's laws, series and parallel connections, and nodal and loop analysis |
| **CO2** | Analyze single-phase AC circuits consisting of RL, RC, and RLC series circuits, including series resonance and band width |
| **CO3** | Demonstrate knowledge of magnetic circuits and their properties, including Faraday's laws of electromagnetic induction, dynamically and statically induced EMF, and self and mutual inductance |
| **CO4** | Explain the principle and operation of DC machines, including DC generators and motors, and understand their performance characteristics and speed control methods. |
| **CO5** | Describe the principle, operation, and construction of AC machines, including single-phase transformers and three-phase induction motors, and understand their losses, efficiency, and testing methods. |

**UNIT – I: DC & AC Circuits**

Electrical circuit elements (R - L and C) - Kirchhoff laws - Series and parallel connection of resistances with DC excitation. Nodal and loop analysis. Thevenin's and Superposition 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 RL - RC - RLC series circuits.Series Resonance and band width.

.**UNIT-II: Poly phase & Magnetic circuits**

Generation of 3-phase voltages - phase sequence - star & delta connections - voltage, current & power in star & delta connected systems - analysis of 3-phase balanced circuits - measurement of 3-phase power by 2 wattmeter method.

Faraday's Laws of Electromagnetic Induction .Dynamically induced EMF –Statically induced EMF – Self Inductance – Mutual Inductance - Coefficient of coupling –Inductances in Series – Inductances in parallel – Dot convention

**UNIT-III: DC Machines**

Principle and operation of DC Generator - EMF equation - OCC characteristics of DC generator – Principle and operation of DC Motor – Performance Characteristics of DC Motors - Speed control of DC Motors.

**UNIT-IV: AC Machines:**

Principle and operation of Single Phase Transformer - EMF equations-losses in transformers, regulation and efficiency. OC and SC test on transformer – auto transformer.

Principle, operation and construction of Three phase Induction Motor –torque equation and torque slip characteristics-power losses and efficiency.

**UNIT-V: Semiconductor Devices:**

Characteristics of Semiconductor junction Diode, Zener diode, transistor, JFET, UJT, SCR and their applications.Half-wave, Full-wave rectifiers and Bridge rectifier, with (L and LC) and without filters.

Bipolar Junction Transistor: Transistor operation, Common base configuration, Common emitterconfiguration, Transistor amplifying action, Common collector configuration, Operating point

## TEXT BOOKS:

1) D. P. Kothari and I. J. Nagrath, “Basic Electrical Engineering”, Tata McGraw Hill, 2010.
2) E. Hughes, “Electrical and Electronics Technology”, Pearson, 2010.

## REFERENCE BOOKS:

1) L. S. Bobrow, “Fundamentals of Electrical Engineering”, Oxford University Press, 2011.
2) D. C. Kulshreshtha, “Basic Electrical Engineering”, McGraw Hill, 2009.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 | PS O4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | - | - | - | - | - | - | - | 3 | 3 | 3 | - | 2 | 2 |
| CO2 | - | - | - | 2 | 2 | - | - | 1 | - | 3 | 3 | 3 | - | - | - | - |
| CO3 | 2 | 2 | 2 | - | - | - | - | - | - | - | - | - | 3 | 3 | 2 | 2 |
| CO4 | - | - | - | - | - | 2 | 2 | 2 | 2 | 2 | - | 3 | 3 | - | - | - |
| CO5 | - | - | 2 | - | - | 1 | 1 | - | - | - | 3 | 1 | 2 | - | - | - |
| AVG_CO | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 1 | 2 | 1 | 1 | 1 |

# ME114 (R20):: ENGINEERING GRAPHICS

## CE/ME 114 (R20)

| L-3 | T-1 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

- Developing an understanding of the basic principles and techniques of technical drawing.
- Learning how to use drafting tools and equipment, such as drawing boards, T-squares, and compasses.
- Understanding the different types of lines, dimensions, and scales used in engineering drawing.
- Learning how to create different types of engineering drawings, including orthographic, isometric, and perspective drawings.
- Developing skills in reading and interpreting engineering drawings, including the ability to understand different views and sections.

### COURSE OUTCOMES:

1) To understand how to construct and analyze different types of curves used in engineering design and manufacturing to study conic sections, cycloids, helixes, spirals, and involutes.
2) To analyze their drawing skills through regular practice of the different techniques taught in the course, including freehand sketching, orthographic and isometric projections.
3) Applying of their drawing skills through regular practice of the different techniques taught in the course, including orthographic projections, section views, and dimensioning.
4) To understand various topics such as projections of lines in different planes, true length and true inclination of lines, and projection of planes in different planes, true shape and true size of planes, and the concept of auxiliary planes.
5) To evaluatevarious topics such as sectioning of solids, different types of sections, and the application of sectioning in engineering design and manufacturing. Understand and learn how to use computer-aided design software to create 2D models of solid objects with sections.

### UNIT-I

**Introduction to Engineering graphics:** Principles of Engineering Graphics and their significance-Conventions in drawing-lettering - BIS conventions. Dimensioning principles and conventional representations

a) Conic sections including the rectangular-hyperbola- general method only, b) Cycloid, epicycloids and hypocycloid, c) Involutes

**UNIT-II**

**Projection of points, lines and planes:** Projection of points in any quadrant, lines inclined to one or both planes, finding true lengths, angle made by line. Projections of regular plane surfaces.

**UNIT-III**

**Projections of solids:** Projections of regular solids inclined to one or both planes by rotational.

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

**UNIT-IV**

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

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

**UNIT-V**

Orthographic Projections: Systems of Projections, Orthographic Projection (Simple Figures)

**UNIT-VI**

**(DEMONESTRATION ONLY)**

Computer Aided Drafting (Using any standard package): Setting up a drawing: starting, main menu (New, Open, Save, Save As etc.), Opening screen, error correction on screen, units, co-ordinate system, limits, grid, snap, ortho.

Tool bars: Draw tool bar, object snap tool bar, modify tool bar, dimension tool Bar Practice of 2D Drawings: Exercises of Orthographic views for simple solids using all commands in various tool bars.

## TEXT BOOKS:

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

## REFERENCE BOOKS:

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

## CO-PO/PSO MATRIX MAPPING:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 3 | 3 | 3 | 3 |
| **CO6** | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 2 | 3 | 3 | 3 |

# ME115 (R20): COMPUTER PROGRAMMING WITH C

## CE/ME/EE/EC/CS 115 (R20) (COMMON TO ALL BRANCHES)

| L-3 | T-1 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

## COURSE OUTCOMES:

After completion of this course, students will be able to

| | |
|---|---|
| **CO1** | Design and develop flowcharts using Raptor to solve simple problems related to basic programming constructs |
| **CO2** | Write basic programs in C using different data types, operators, and control structures |
| **CO3** | Develop programs using functions and understand concepts like scope, storage classes, and recursion |
| **CO4** | Implement programs using arrays, pointers, and strings for solving problems Related to data manipulation. |
| **CO5** | Understand the concept of structures and files in C programming, and develop programs using structures and file handling functions. |

**Unit I: Flowchart design through Raptor**

Flow chart symbols, Input/Output, Assignment, operators, conditional if, repetition, function and sub charts. Example problems(section 1) – Finding maximum of 3 numbers, Unit converters, Interest calculators, multiplication tables, GCD of 2 numbers

Example problems(section 2) - Fibonacci generation, prime number generation. Minimum, Maximum and average of n numbers, Linear search, Binary Search.

**Unit II: C Basics**

C-Basics: C-character set, Data types, Constants, Expressions, Structure of C program, Operators and their precedence & associatively, Simple programs in C using all the operators, Type casting ,type coercion.

**Unit III: Control Structures and Functions**

Control Structures, Basic input and output statements, Preprocessor directives.

Functions: Concept of a function, passing the parameters, automatic variables, scope and extent of variables, storage classes, recursion, iteration vs recursion, types of recursion, Simple recursive and non recursive programs, Towers of Hanoi problem.

**Unit IV: Arrays and Pointers**

Arrays: Single and multidimensional Arrays, Character array as a string, string functions, Programs using arrays and string manipulation.

Pointers: Pointers declarations, Pointer expressions, Pointer parameters to functions. Pointers, Pointers and array, Pointer arithmetic.

**Unit V: Structures and Files**

Structures: Declaring and using structures, operations on structures, structures and arrays, user defined data types, pointers to structures. Command line arguments.

Files: Introduction, file structure, file handling functions, file types, file error handling, Programs using file functions.

## TEXT BOOKS:

1) https://raptor.martincarlisle.com/
2) Programming with C-Gottfried-Schaums Outline Series-TMH
3) C Programming – AnithaGoel/Ajay Mittal/E.Sreenivasa Reddy-Pearson India

## REFERRENCE BOOKS:

1) Problem Solving with C- Somasekharan-PHI.
2) C Programming- Behrouz A forouzan – CENGAGE Learning
3) Test your c skills-Yaswanthkanithker
4) Let us C- Yaswanthkanithker

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | - | - | 2 | - | 2 | - | - | - | - | - | 1 | 1 |
| **CO2** | 2 | - | - | 2 | - | - | - | 1 | - | 2 | 2 | 2 | 2 | 2 |
| **CO3** | - | - | 2 | - | 2 | 2 | - | - | - | - | 3 | 3 | 3 | 3 |
| **CO4** | - | 2 | - | - | 2 | 2 | - | - | 2 | - | 3 | - | 3 | 3 |
| **CO5** | 1 | - | - | 2 | - | - | - | 2 | - | - | - | 3 | 1 | 2 |
| **AVG_CO** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 |

# ME151 (R20): MECHANICAL ENGINEERING WORKSHOP

## CE/ME 151 (R20)

| L-0 | T-0 | P-3 | M-100 | C-1.5 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

1) Imparts basic knowledge of various tools and their use in different sections of manufacture such as fitting, carpentry, tin smithy, casting, and welding, electrical wiring.
2) To gain a good basic working knowledge required for the production of various engineering products.
3) To develop a right attitude, team working, precision and safety at work place.
4) To have practical exposure to various welding and joining processes.
5) Identify and use marking out tools, hand tools, measuring equipment and to work to prescribed tolerances

### COURSE OUTCOMES:

1) The Engineering Workshop Practice for engineers is a training lab course spread over entire semester. The modules include training on different trades like Fitting, Carpentry, tinsmith and welding which makes the students to learn how various joints are made using wood and other metal pieces.
2) Student will be able to make various joints in the given object with the available workmaterial. Student will be able to know how much time a joint will take for the assessment of time
3) Students will develop the ability to use various hand tools and measuring instruments used in mechanical engineering workshops, such as hammers, screwdrivers, pliers, wrenches, calipers, and micrometers
4) Will gain knowledge of the different manufacturing processes which are commonly employed in the industry to fabricate components using different materials.
5) Students will be able to gain the manufacturing skills and get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.

### LIST OF EXPERIMENTS:

Minimum three experiments should be conducted from each trade

**1. CARPENTRY**

To make the following jobs with hand tools

a) Lap joint b) Lap Tee joint c) Dove tail join d) Mortise & Tenon joint e) Cross-Lap joint

**2.WELDING USING ELECTRIC ARC WELDING PROCESS / GAS WELDING.**

The following joints to be welded.

a) Lap joint b) Tee joint c) Edge joint d) Butt joint e) Corner joint

**3. SHEET METAL OPERATIONS WITH HAND TOOLS.**

a) Rectangular Tray b) Triangular Tray c) Pipe Joint d)Funnel e)Rectangular Scoop

**4. HOUSE WIRING**

a) To connect one lamp with one switch
b) To connect two lamps with one switch
c) To connect a fluorescent tube
d) Stair case wiring
e) Go down wiring

## REFERENCE BOOKS:

1) Kannaiah P. & Narayana K. C., "Manual on Work Shop Practice", Scitech Publications, Chennai, 1999.
2) Workshop Lab Manual, R.V.R. & J.C. College of Engineering, Guntur

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 2 | 2 | | | | | | 2 | 3 | 2 | 2 |
| **CO2** | 2 | 3 | 2 | 2 | 3 | 3 | | | | | | 3 | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 3 | 2 | | | | | | 3 | 3 | 2 | 2 |
| **CO4** | 3 | 2 | 2 | 3 | 3 | 2 | | | | | | 2 | 3 | 3 | 2 |
| **CO5** | 3 | 2 | 3 | 2 | 2 | 3 | | | | | | 2 | 3 | 2 | 2 |

# ME152 (R20): ENGINEERING CHEMISTRY LABORATORY

## ME/CE 152 (R20)

| L-0 | T-0 | P-3 | M-100 | C-1.5 |
|---|---|---|---|---|

**COURSE OBJECTIVES:**

- To understand technology involved in analysis and improving quality of water as commodity.
- To understand structure, properties and applications of speciality polymers and nano material.
- To bring adaptability to the concepts of chemistry and to acquire the required skillsto become a perfect engineer.
- To impart the basic knowledge of atomic, molecular and electronic modificationswhich makes the student to understand the technology based on them.
- To acquire the knowledge of electrochemistry, corrosion and water treatment whichare essential for the Engineers and in industry.
- To acquire the skills pertaining to spectroscopy and to apply them for medical fieldetc.

**COURSE OUTCOMES:**

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

| | |
|---|---|
| **CO1** | Explain various methods of volumetric analysis i.e. Redox, Iodometric, complexometric, Neutralization etc. and use of conductivity meter for measurement of conductance of water sample. |
| **CO2** | Apply the use of internal and external indicators and their comparison for redox titrations and mechanisms of iodometric titrations and use of double indicator method in a single titration. |
| **CO3** | Estimate the % values of moisture, volatile matter, ash and carbon of fuel by Proximate analysis and instrument handling |
| **CO4** | Analyse the properties of lubricants viz. Flash & fire point, viscosity, cloud & pour point and their significance. |
| **CO5** | Produce a coherent paragraph interpreting a figure/graph/chart/table (L4) Explain synthetic technique of drug like Aspirin, Paracetamol etc. |

## LIST OF EXPERIMENTS:

1) Determination of hardness of water by EDTA method
2) Estimation of Mohr's salt by Permanganometry
3) Estimation of Mohr's salt by Dicrometry
4) Determination of alkalinity of water
5) Percentage of purity of washing soda
6) Determination of available chlorine in bleaching powder
7) Preparation of Urea-formaldehyde resin
8) Determination on strength of NaoH using HCl onductometrically
9) Acid-Base titration by $P^H$ meter
10) Acid-Base titration by Potentiometer
11) Determination of viscosity of lubricating oil
12) Determination of Surface tension

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | - | - | 1 | - | - | - | - | - | - | - | - |
| **CO2** | 2 | - | - | 1 | - | - | - | - | - | - | - | - |
| **CO3** | 2 | 1 | - | 2 | 3 | - | - | - | - | - | - | - |
| **CO4** | 2 | 1 | - | 2 | 3 | - | - | - | - | - | - | - |
| **CO5** | 2 | - | 1 | - | - | - | - | - | - | - | - | - |

# ME153 (R20): COMPUTER PROGRAMMING USING C LAB

## CE/ME/EE/EC/CS 153 (R20)

| L-0 | T-0 | P-3 | M-100 | C-1.5 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

This course provides the fundamental concepts of programming using C language, apply the control structures, iterations statements, arrays, functions, strings, pointers, structures, unions and files. This course also explains the concepts of searching and sorting techniques in C language.

**SOFTWARE REQUIREMENTS:** Turbo C

### COURSE OUTCOMES:

| | |
|---|---|
| **CO 1** | Understand and apply fundamental programming concepts such as variables, data types, operators, control structures, functions, arrays, pointers, and structures in C language. |
| **CO 2** | Develop efficient algorithms and use appropriate data structures to solve programming problems in C |
| **CO 3** | Demonstrate the ability to write and debug C programs using appropriate tools and techniques, including integrated development environments (IDEs) and debugging utilities |
| **CO 4** | Evaluate the efficiency and complexity of C programs in terms of time and space complexity, and apply appropriate techniques to optimize program performance. |
| **CO 5** | Work collaboratively in teams to develop complex C programs, and effectively communicate technical information and programming solutions to others. |

### CYCLE 1:

1. Construct flowcharts to
   a) calculate the maximum, minimum and average of N numbers
   b) develop a calculator to convert time, distance, area, volume and temperature from one unit to another.
2. Construct flowcharts with separate procedures to
   a) calculate simple and compound interest for various parameters specified by the user
   b) calculate the greatest common divisor using iteration and recursion for two numbers as specified by the user
3. Construct flowcharts with procedures to
   a) generate first N numbers in the Fibonacci series
   b) generate N Prime numbers
4. Design a flowchart to perform Linear search on list of N unsorted numbers (Iterative and recursive)
5. Design a flowchart to perform Binary search on list of N sorted numbers (Iterative and recursive)
6. Design a flowchart to determine the number of characters and lines in a text file specified by the user

**CYCLE 2:**

1. Exercises on data types and operators?
   a) Practice exercises 3.1 to 3.16 and 4.1 to 4.17 and 14.1 to 14.20 Test your C Skills - yaswanthkanitkar text book.
   b) Write a program which determines the largest and the smallest number that can be stored in different data types of like short, int., long, float and double. What happens when you add 1 to the largest possible integer number that can be stored?
   c) Write a program to find greatest of three numbers using conditional operator?
   d) Write a program to swap two numbers with and without temp variable?
   e) Practice a program using multiple unary increment and decrement operators in arithmetic expressions?
2. Exercises on control structures?
   a) Practice exercise 2.1 to 2.15 Test your C Skills - yaswanthkanitkar text book.
   b) Write a program to find greatest of three numbers? Use nested if, if else if and switch statements?
   c) Write a program to read marks of a student and print the sum and average?
   d) Display the grade based on the sum of marks?
   e) Write a program to count the digits of a number? Use for loop
   f) Write a program to check whether a number is perfect or not? Use do-while
   g) Write a program to check whether a number is strong or not? Use while
   h) Write a program to check whether a number is amstrong or not? Use for
   i) Write a program to check whether a number is palindrome or not? Use for
   j) Write a program to find the Fibonacci series upto the given number? Use while
   k) Write a program to print the pascals triangle? Used do-while
   l) Write a program to print the result of the series 1+x^2/2+x^3/3+….+x^n/n
3. Exercises on functions?
   a) Practice exercise 5.1 to 5.14 Test your C skills -yaswanthkanitkar text book.
   b) Write program to swap two variables using functions? Write a program to perform menu driven arithmetic operations using functions?
   c) Write a program to find the factorial of a number using recursive and non- recursive functions?
   d) Write a program to find the Fibonacci series using recursive functions?
   e) Write a program to find the solution for towers of Hanoi using recursive function?
   f) Write a program to pass parameters to a functions using call by value and call by reference?
4. Exercises on Arrays?
   a) Practice exercise 9.1 to 9.17 Test your C skills - yaswanthkanitkar text book.
   b) Write a program to read n numbers and sort them?
   c) Write a program to find the minimum and maximum numbers of the array?
   d) Write a program to read two matrices and find their sum, difference and product of them?
   e) Find the transpose of a matrix?
   f) Write a program to print upper and lower triangle of a given matrix?

5. Exercises on strings?
   a) Practice exercise 10.1 to 10.15 yaswanthkanitkar text book.
   b) Write a program to demonstrate the use of string manipulation functions?
   c) Write a program to compare two strings?
   d) Write a program to sort the names in Alphabetical order?
6. Exercises on pointers?
   a) Practice exercise 7.1 to 8.26 yaswanthkanitkar text book.
   b) Write a program to read dynamic array and sort the elements?
   c) Write a program to read dynamic array and find the minimum and maximum of the elements?
   d) Write a program to perform pointer arithmetic?
   e) Write a program on pointers for strings?
   f) Write a program to use array of pointers?
7. Exercises on structures?
   a) Practice exercise 11.1 to 11.30 yaswanthkanitkar text book.
   b) Write a program to create student structure and read marks of three subjects and find the sum and total of the student?
   c) Write a program on arrays of structures for 60 students record using the above student structure?
   d) Write a program for complex structure? Perform addition, subtraction and multiplication of two complex numbers?
   e) Write a program for addition and multiplication of two polinomials?
   7. Write a program on Files?
   a) Practice exercise 12.1 to 12.20 yaswanthkanitkar text book.
   b) Write a program to append content of a file?
   c) Write a program to display the content of a file?
   d) Write a program to copy content of one file to other file?
   e) Write a program to count the no of characters in a file?
   f) Write a program to compare the contents of two files?

## REFERENCE BOOKS:

1) Test your C Skills by – Yaswanth Kanithkar-BPB Publishers
2) C programming; Test your skills-A.N.Kamthane-Pearson India

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | - | - | - | - | 2 | 2 | 2 | - | - | 2 | 2 | 2 | 1 |
| **CO2** | - | 2 | 2 | 2 | - | - | 1 | 2 | - | 2 | 2 | 2 | 3 | 1 |
| **CO3** | 1 | - | 2 | 1 | - | - | 1 | - | 1 | - | 2 | 2 | 3 | 1 |
| **CO4** | 2 | - | - | 2 | - | - | - | 1 | 1 | 2 | 2 | 2 | 3 | 1 |
| **CO5** | - | 2 | 1 | - | 2 | - | - | 1 | - | - | 2 | 2 | 2 | 1 |
| **CO** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 1 |

# I/IV B.Tech.
# SEMESTER II

# B.Tech. MECHANICAL ENGINEERING

## SEMESTER-II

## ME121 (R20): MATHEMATICS-II

## CE/ME/EE/EC/CS 121 (R20)

**(ODE, PDE AND MULTIVARIABLE CALCULUS) (COMMON TO ALL BRANCHES)**

| L-3 | T-1 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

- To learn about differential equations asd its solutions of first and higher order.
- To enlighten the learners in the concept of differential equations and multivariable calculus.
- To furnish the learners with basic concepts and techniques at plus two level to lead them into advanced level by handling various real world applications.

### COURSE OUTCOMES:

| | |
|---|---|
| **CO 1** | Using variable separable method and using other methods solving the higher order differential equation. |
| **CO 2** | Reducing the given differential equations and solving for the required solutions. |
| **CO 3** | Student should be known about first order partial differential equations and its solutions obtained by using different methods. |
| **CO 4** | Student should able to understand about vectors, vector differentiation methods. |
| **CO 5** | Student should able to find vector integration by using different methods and also applications of vectors in various fields. |

**UNIT I: Linear Differential Equations of Higher Order**

Definitions, complete solution, operator D, rules for finding complimentary function, inverse operator, rules for finding particular integral, method of variation of parameters.

**UNIT II: Equations Reducible to Linear Differential Equations and Applications**

Cauchy's and Legendre's linear equations, simultaneous linear equations with constant coefficients.

**UNIT III: Partial Differential Equations – First order**

First order partial differential equations, solutions of first order linear and non-linear PDEs.

Solutions to homogenous and non-homogenous higher order linear partial differential equations.

**UNIT IV: Multivariable Calculus (Vector differentiation)**

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

**UNIT V: Multivariable Calculus (Vector integration)**

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof).

## TEXT BOOKS:

1) Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.
2) B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna publishers, 2017.

## REFERENCE BOOKS:

1) Dennis G. Zill and Warren S. Wright, Advanced Engineering Mathematics, Jones and Bartlett, 2011.
2) Michael Greenberg, Advanced Engineering Mathematics, 2/e, Pearson, 2018
3) George B. Thomas, Maurice D. Weir and Joel Hass, Thomas Calculus, 13/e, Pearson Publishers, 2013.
4) R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002.
5) Glyn James, Advanced Modern Engineering Mathematics, 4/e, Pearson publishers, 2011

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 2 | - | - | - | - | - | - | - | 2 | 3 | - | - | - |
| **CO2** | 1 | 3 | - | - | - | - | - | - | - | 1 | 3 | - | - | - |
| **CO3** | 2 | 3 | - | - | - | - | - | - | - | 2 | 2 | - | - | - |
| **CO4** | 2 | 2 | - | - | - | - | - | - | - | 3 | 2 | - | - | - |
| **CO5** | 1 | 2 | - | - | - | - | - | - | - | 3 | 3 | - | - | - |
| **AVG_CO** | 1 | 2 | - | - | - | - | - | - | - | 2 | 3 | - | - | - |

# ME122 (R20): ENGINEERING PHYSICS

## ME/CE 122 (R20)

| L-3 | T-1 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

At the end of the Course/Subject, the students will:

| | |
|---|---|
| **CO1** | Understand the phenomena of light- Interference, diffraction, and analyze the differences between interference and diffraction with applications. |
| **CO2** | Explain the concepts of lasers and fiber optics and apply them in various fields of engineering. |
| **CO3** | Understand the significance of wave function, concepts of classical, quantum free electron theories and classify the materials based on band theory. |
| **CO4** | Explain various types of polarizations of dielectrics, classify the magnetic materials and apply the magnetic, dielectric materials for given engineering applications. |
| **CO5** | Explain the types of semiconductors and Classify superconductors based on Meissner's effect. |

### COURSE OUTCOMES:

**UNIT-I:**

**Interference:** Principle of Superposition-Interference of light-Theory of Interference fringes-Conditions for sustained Interference-Interference in thin films by reflected light-Newton's Rings-Determination of Wavelength.

**Diffraction**: Fraunhofer Diffraction-Single slit Diffraction-Diffraction Grating–Grating Spectrum -Determination of Wavelength.

**UNIT-II**

**Lasers**: Laser characteristics, Spontaneous and Stimulated emissions, Basic requirements of a laser, Population inversion – Solid state laser (Ruby laser), Gas (He-Ne) laser, Semiconductor (GaAs) laser, applications of lasers.

**Fiber optics:** Introduction to Optical Fibers-Principle of optical fiber-Critical angle, Acceptance angle-Numerical Aperture-Classification of fibers based on Refractive index profile, Modes-Propagation of electromagnetic wave through optical fiber - Fiber optic Communication system-applications of Optical fibers.

**Unit– III**

**Dielectrics:** Introduction to Dielectrics--Electric polarization-Dielectric polarizability, Susceptibility and Dielectric constant- Types of polarizations-Lorentz (internal) field - Claussius -Mossotti equation.

**Magnetics:** Introduction to Magnetics-Magnetic dipole moment-Magnetization-Magnetic susceptibility

and permeability-Origin of permanent magnetic moment-Classification of Magnetic materials-Hysteresis-soft and hard magnetic materials- applications of magnetic materials.

**Unit – IV: Semiconductors**

Origin of energy band formation in solids-Classification of materials into conductors, semi-conductors & insulators – Semiconductors-Intrinsic semiconductors-dependence of Fermi level on carrier concentration and temperature(Qualitative)- Extrinsic semiconductors - P-type & N-type-dependence of Fermi level on carrier concentration and temperature (Qualitative)- Direct and Indirect band gap semiconductors-Hall effect- applications of Semiconductors.

**Unit-V**

**Principles of Quantum Mechanics:** Dual nature of light, Matter waves & properties, de Broglie's concept of matter waves, Davisson and Germer experiment, Heisenberg's uncertainty principle and application (non-existence of electron in nucleus). One dimensional time independent Schrodinger's wave equation, Physical significance of the wave function, Particle in a box (one dimensional).

**Superconductivity**: First experiment, critical parameters (Tc, Hc, Ic), Meissner effect, BCS Theory (in brief) and Applications of superconductors.

## TEXT BOOKS:

1) M.N. Avadhanulu, P.G.Kshirsagar "A Text book of Engineering Physics"-S.Chand Publications,2017
2) H.K.Malik & A.K.Singh "Engineering Physics",- McGraw Hill Publishing Company Ltd, 2018
3) Gaur R.K. and Gupta S.L., "Engineering Physics"- Dhanpat Rai publishers, 2012

## REFERENCE BOOKS:

1) Gerd Keiser "Optical Fiber Communications"- 4/e, Tata McGraw Hill ,2008
2) S.M. Sze "Semiconductor devices-Physics and Technology"-Wiley,2008
3) D.K. Bhattacharya and A. Bhaskaran, "Engineering Physics"- Oxford Publications-2015

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 2 | - | - | - | - | - | - | - | - | - |
| **CO3** | 3 | 2 | - | - | - | - | - | - | - | - | - | - |
| **CO4** | 3 | 3 | - | - | - | - | - | - | - | - | - | - |
| **CO5** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - |
| **Total** | 15 | 13 | 4 | - | - | - | | - | - | - | - | - |
| **Average** | 3 | 3 | 2 | - | - | - | - | - | - | - | - | - |

| Course Outcome | Course Outcome Statement | Bloom's Taxonomy | Level |
|---|---|---|---|
| **CO1** | Distinguish the phenomena of light- Interference, diffraction, and determination of the wavelength of given light using these phenomena. | **Remember & understand** | **1 & 2** |
| **CO2** | Apply the concepts of light in optical fiber and lasers in communication system. Use of fibers in communication system. Major applications of fibers and Lasers in medical field. | **Application** | **3** |
| **CO3** | Classify the magnetic materials and apply the magnetic, dielectric materials for given engineering applications. | **Application** | **3** |
| **CO4** | Classify the semiconductors and study the properties of Semiconductors. Hall effect. | **Analyzing** | **4** |
| **CO5** | Calculate the energy of quantum particle at different energy levels, de Broglie's hypothesis, Schrodinger's wave function and its applications, study of the properties of superconductors. BCS Theory of Superconductivity | **Analyzing** | **4** |

# ME123 (R20): PROFESSIONAL COMMUNICATION SKILLS

## ME/CE 123 (R20)

| L-3 | T-1 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

The course aims to inculcate a sense of professionalism among the students while emphasizing on the basic aspects of the language learning such as grammar and vocabulary building. It also aspires to train the students to meet the global challenges.

- Adopt activity-based teaching-learning methods to ensure that learners would be engaged in use of language in the classroom sessions.
- Focus on appropriate reading strategies for comprehension of various academic texts and authentic materials
- Impart effective strategies for good writing and demonstrate the same in summarizing, writing well organized essays, record and report useful information
- Provide knowledge of grammatical structures and vocabulary and encourage their appropriate use in speech and writing.

### COURSE OUTCOMES:

After completion of this course, students will be able to –

| | |
|---|---|
| **CO1** | Identify the context, topic, and pieces of specific information from social or transactional dialogues spoken by native speakers of English (L3) |
| **CO2** | Formulate sentences using proper grammatical structures and correct word forms (L3) |
| **CO3** | Speak clearly on a specific topic using suitable discourse markers in informal discussions |
| **CO4** | Write summaries based on global comprehension of reading texts (L3) |
| **CO5** | Produce a coherent paragraph interpreting a figure/graph/chart/table (L4) |

### UNIT-I:

Reading: Listening Skills – The Boy who broke the Bank (English & Soft Skills)

1) Writing: Paragraph Writing
2) Grammar: Common Errors in Nouns- Pronoun Agreement
3) Vocabulary Building: Functional word list -100

**UNIT- II:**

1) Reading: Assertive Skills – The Verger (English & Soft Skills)
2) Writing: Letter Writing (Formal and Informal)
3) Grammar: Correction of Errors in Subject- Verb Agreement
4) Vocabulary Building: Sign Post

**UNIT - III:**

1) Reading: Learning Skills – Three Questions (English & Soft Skills)
2) Writing: Note Making, Note Taking
1) Grammar: Correction of in Tense Usage
2) Vocabulary Building: One Word Substitutes

**UNIT - IV:**

1) Reading: Adaptability Skills – Senor Payroll (English & Soft Skills)
2) Writing: Pictorial Description
3) Grammar: Correction of Errors in Adjectives, Articles, Prepositions
4) Vocabulary Building: Synonyms and Antonyms

**UNIT - V:**

1) Reading: Written Communication Skills - Gateman's Gift (English & Soft Skills)
2) Writing: Information Transfer
3) Grammar: Correction of Errors in Wh- questions, Question Tags
4) Vocabulary Building: Idioms and Phrasal Words (200)

## TEXT BOOKS:

1) Dhanavel S. P. *English and Soft Skills*, Orient Black Swan Pvt. Limited, 2013.
2) Barun K Mitra, *Effective Technical Communication*, Oxford University Publication, 2014.

## REFERENCE BOOKS:

1) Bailey, Stephen. *Academic writing: A handbook for International Students*. Routledge, 2014.
2) Chase, Becky Tarver. *Pathways: Listening, Speaking and Critical Thinking.* Heinley ELT; 2nd Edition, 2018.
3) Hewings, Martin. *Cambridge Academic English (B2)*. CUP, 2012.
4) Michael Swan. *Practical English Usage*, OUP. 1995.
5) F.T. Wood. *Remedial English Grammar,* Macmillan.2007
6) Liz Hamp-Lyons and Ben Heasly. *Study Writing*, Cambridge University Press. 2006.
7) Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad.

8) Sharon J.Gerson, Steven M.Gerson, *Technical Writing*, New Delhi: Pearson education, 2007.

9) Sanjay Kumar and Pushp Lata, *Communication Skills*, Noida: Oxford University Press, 2012.

10) Dr. ShaliniVerma, *Word Power Made Handy*, S. Chand & Co Ltd., 2009.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | 2 | 2 | - | - | 2 | 3 | - | 3 | 3 | - | - |
| **CO2** | - | - | - | 2 | 2 | | | 2 | 3 | - | 3 | 3 | - | - |
| **CO3** | - | - | - | 2 | 2 | - | - | 2 | 3 | - | 3 | 3 | - | - |
| **CO4** | - | - | - | 2 | 2 | | | 2 | 3 | - | 3 | 3 | - | - |
| **CO5** | - | - | - | 2 | 2 | - | - | 2 | 3 | - | 3 | 3 | - | - |
| **AVG_CO** | - | - | - | 2 | 2 | | | 2 | 3 | - | 3 | 3 | - | - |

# ME124 (R20): PYTHON PROGRAMMING

## ME 124 (R20)

| L-3 | T-1 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

This course enables the students to understand the fundamentals of python programming, describe the various operators and control flow statements, analyse various data structures, make use of functions, discuss about MODULE s, packages in python, object oriented concepts, exception handling, illustrate advanced concepts like multithreading, graphics and generate various test cases.

### COURSE OUTCOMES:

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

| | |
|---|---|
| **CO1** | Understand the basic building blocks in python programming language to construct different applications. |
| **CO2** | Apply the necessary data structures to solve a given problem. |
| **CO3** | Extract and import packages for developing different solutions for real time problems. |
| **CO4** | Implement the problems in terms of real -world objects using concept of OOPS. |

**Unit I:**

**Context of software development:** Software, Development tools, Learning programming with Python, Writing a python program.

**Values and Variables**: Variables and assignments, identifier, Control codes within Strings, User Input, The eval function, the print function.

**Expressions and Arithmetic:** Expressions, Operator precedence and Associativity, Comments, Errors, More arithmetic operators.

**Unit II:**

**Conditional Execution:** Boolean Expressions, Simple if and if else, nested conditionals, multiway decision statements, conditional expressions, errors in conditional statements.

**Iteration:** While statements, for statement, definite loops and indefinite loops, nested loops, abnormal loop termination, infinite loops, iteration examples: computing square root, drawing a tree, printing prime numbers.

**Unit III**

**Functions:** Introduction, standard mathematical functions, time functions, Random numbers, main function, parameter passing, Function examples: Better organized prime number, Command Interpreter, Restricted Input, Better Die rolling simulator, Tree-Drawing Function, Floating –Point equality, Custom functions Vs Standard functions.

**More on Functions**: Global variables, Default Parameters, recursion, Making functions reusable, documenting functions and modules, functions as data.

**Unit IV:**

**Lists:** Using Lists, List assignment and equivalence, list bounds, Slicing, Lists and functions, Prime generation with a list

**Lists processing:** Sorting, flexible sorting, search, list permutations, randomly permuting a list, reversing a list.

**Unit V:**

**Objects:** Using Objects, String Objects, List Objects.

**Custom types:** geometric points, Methods, Custom type examples, Class inheritance.

**Handling Exceptions:** Motivation, Exception examples, Using Exceptions, Custom Exceptions.

## TEXT BOOKS:

1) LEARNING TO PROGRAM WITH PYTHON Richard L. Halterman.
2) Core Python Programming by Dr. R.NageswaraRao, dreamtech, second edition.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | - | - | - | - | - | 2 | - | - | 3 | 2 | 1 |
| **CO2** | 2 | 2 | 2 | - | - | - | - | - | 2 | - | - | 3 | 1 | 2 |
| **CO3** | 2 | 2 | 2 | - | - | - | - | - | 2 | - | - | 3 | 3 | 2 |
| **CO4** | 2 | 2 | 2 | - | - | - | - | - | 2 | - | - | 3 | 3 | 1 |
| **AVG_CO** | 2 | 2 | 2 | - | - | - | - | - | 2 | - | - | 3 | 2 | 2 |

# ME125 (R20): ENGINEERING MECHANICS

## ME/CE 125 (R20)

| L-3 | T-1 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OUTCOMES:

After completion of this course, students will be able to –

| | |
|---|---|
| **CO1** | Determine resultants and apply conditions of static equilibrium to plane force systems. |
| **CO2** | Develop complete and correct free body diagrams and Write the appropriate equilibrium equations from the free body diagrams. |
| **CO3** | Analyze systems that include frictional forces. |
| **CO4** | Locate the centroid of area, moment of inertia, product of inertia of various shape. |
| **CO5** | Apply the theorem of virtual work on beam, frame and link problem. |

**Unit I**

**Introduction to Engineering Mechanics:** Composition and resolution of forces, parallelogram law, principle of transmissibility, types of force systems - concurrent and concurrent coplanar forces, resultant of coplanar force systems couple, moment of a force Varignon's theorem, concept of free body diagrams, concept of equilibrium of coplanar force systems.

**Friction**: Laws of friction, types of friction, equilibrium of force systems involving frictional forces, wedge friction. Free body diagrams involving frictional forces.

**Unit II**

**Analysis of Structures:** Introduction to plane trusses, analysis of plane trusses by method of joints and method of sections.

**Properties of Surfaces and Volumes:** Centroid and center of gravity, derivation of centroids from first moment of area, centroids of composite sections, center of gravity of common volumes - cylinder, cone, sphere, theorem of Pappus-guidinus.

**Unit III**

**Moment of Inertia**: Area moment of inertia of plane and composite shapes, parallel axis theorem, perpendicular axis theorem, polar moment of inertia, mass moment of inertia of common volumes -thin plates, thin rod, cylinder, cone, sphere, rectangular prism, radius of gyration.

**Unit IV**

**Kinematics:** Equations of motion for rigid bodies, constant and variable acceleration, rectilinear and curvilinear motion, motion under gravity -projectile motion, use of rectangular coordinates, tangential and normal coordinates.

**Unit V**

**Kinetics:** Principles of dynamics - Newton's Laws of motion, D'Alembert's principle in rectilinear translation, principle of work and energy.

**Ideal Systems**: Principle of conservation of energy, concept of power, conservation of linear and angular momentum, principle of momentum and impulse.

## TEXT BOOKS:

1) N H Dubey, Engineering Mechanics: Statics and Dynamics, McGraw Hill, 2014.
2) S Timoshenko, DH Young, JV Rao, Sukumar Pati, Engineering Mechanics (in SI units), 5/e, McGraw Hill, 20
3) S S.Bhavikatti, Engineering Mechanics, 4/e, New Age International, 2008.

## REFERENCE BOOKS:

1) Basudeb Bhattacharya., Engineering Mechanics, 2/e, Oxford University Press (India), 2015.
2) Irving Shames, G K M Rao, Engineering Mechanics: Statics and Dynamics, 4/e, Pearson, 2009.
3) K L Kumar, Veenu Kumar, Engineering Mechanics, 4/e, Tata McGraw Hill, 201

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | - | - |
| **CO2** | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | - | - |
| **CO3** | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | - | - |
| **CO4** | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | - | - |
| **CO5** | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | - | - |
| **AVG_CO** | 2 | 2 | 1 | - | - | - | - | - | - | - | - | 1 | - | - |

# ME126: ENVIRONMENTAL SCIENCE

## ME/CE 126 (R20)

| L-3 | T-1 | P-0 | M-100 | C-3 |
|---|---|---|---|---|

### COURSE OBJECTIVE:

To make the students to get awareness on environment, to understand the importance of protecting natural resources, ecosystems for future generations and pollution causes due to the day to day activities of human life to save earth from the inventions by the engineers.

### COURSE OUTCOMES:

After completion of this course, students will be able to –

| | |
|---|---|
| **CO1** | Gain knowledge about environment and importance of Environmental Studies in the life. They have to know about resources, its importance and environmental impacts of human activities on natural resources. |
| **CO2** | Students will learn about the Ecosystem functioning and Importance of biodiversity and its Conservation. |
| **CO3** | Gain knowledge about the environmental pollution control, management of waste and pollution related aspects |
| **CO4** | Aware students about social issues and natural calamities, constitutional tools provisions for human welfare. |
| **CO5** | Students will learn about increase in population growth and its impact on environment and study of different ecosystems through field visit. |

### UNIT – I: MULTI DISCIPLINARY NATURE OF ENVIRONMENTAL STUDIES

Definition, Scope and Importance – Need for Public Awareness.

**NATURAL RESOURCES :** Renewable and non-renewable resources – Natural resources and associated problems – Forest resources – Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people – Water resources – Use and over utilization of surface and ground water – Floods, drought, conflicts over water, dams – benefits and problems – Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies – Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. – Energy resources.

**UNIT – II: Ecosystems, Biodiversity, and its Conservation**

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

**BIODIVERSITY AND ITS CONSERVATION :** Definition: genetic, species and ecosystem diversity – Bio-geographical classification of India – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts – Endangered and endemic species of India – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

**UNIT – III: Environmental Pollution and Solid Waste Management**

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

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

**UNIT – IV: Social Issues and the Environment**

**SOCIAL ISSUES AND THE ENVIRONMENT:** From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, rain water harvesting, watershed management – Resettlement and rehabilitation of people; its problems and concerns. Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies – Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Issues involved in enforcement of environmental legislation – Public awareness.

**UNIT – V: Human Population and the Environment**

**HUMAN POPULATION AND THE ENVIRONMENT:** Population growth, variation among nations. Population explosion – Family Welfare Programmed. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of information Technology in Environment and human health – Case studies.

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

## TEXT BOOKS:

1) Text book of Environmental Studies for Undergraduate Courses by Erach Bharucha for University Grants Commission, Universities Press.
2) Environmental Studies by Palaniswamy – Pearson education
3) Environmental Studies by Dr.S.AzeemUnnisa, Academic Publishing Company

## REFERENCES BOOKS:

1) Textbook of Environmental Science by Deeksha Dave and E.Sai Baba Reddy, Cengage Publications.
2) Text book of Environmental Sciences and Technology by M.Anji Reddy, BS Publication.
3) Comprehensive Environmental studies by J.P.Sharma, Laxmi publications.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 2 | C | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 2 |
| **CO2** | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 2 |
| **CO3** | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 2 |
| **CO4** | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 2 |
| **CO5** | 3 | 3 | 2 | 2 | 3 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 2 |
| **AVG_CO** | 3 | 2 | 2 | 2 | 2 | 2 | 3 | 3 | 1 | 1 | 1 | 1 | 3 | 2 |

# ME161 (R20): ENGINEERING PHYSICS LABORATORY

## ME/CE 161 (R20)

| L-0 | T-0 | P-3 | M-100 | C-1.5 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

At the end of the Course/Subject, the students will:

- To Measure the wavelength of light using optical instruments.
- To determine the numerical aperture and acceptance angle of optical fiber.
- To Study the behavior of semiconducting materials.
- To study the magnetizing behaviour of magnetic materials.
- To measure the dielectric constant of a material.

### COURSE OUTCOMES:

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

| | |
|---|---|
| **CO1** | Examine the physical properties of light using interference and diffraction. |
| **CO2** | Calculate the numerical aperture and acceptance angle of optical fiber |
| **CO3** | Analyze the characteristics of semiconducting material |
| **CO4** | Demonstrate the magnetizing behavior of magnetic materials |
| **CO5** | Calculate the dielectric constant of a material |

### LIST OF PHYSICS EXPERIMENTS:

1) Determination of the radius of curvature of the lens by Newton's ngmethod.
2) Determination of wavelength by plane diffraction grating method.
3) Dispersive power of a Prism.
4) Resolving power of a grating.
5) Photo cell – I-V Characteristic curves and determination of stopping potential.
6) Magnetic field along the axis of a circular coil carrying current.
7) B-H Curve
8) To determine the numerical aperture of a given optical fiber and hence to find its acceptance angle.
9) Hall effect.
10) Photo voltaic cell - Determination of fill-factor.
11) To determine the energy gap of a semiconductor.
12) Determination of Acceleration due to gravity by using compound Pendulum.
13) Poisson's ratio of aluminium and rubber.

14) Rigidity modulus of material by wire-dynamic method (torsional pendulum).
15) Determination of a.c. Frequency – Sonometer.
16) Determine the wavelength of Laser source.

## REFERENCE BOOKS:

1. S. Balasubramanian , M.N. Srinivasan " A Text book of Practical Physics"- S Chand Publishers, 2017
2. http://vlab.amrita.edu/index.php -Virtual Labs, Amrita University

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | - | - | 3 | - | - | - | 3 | - | - | - | - | - |
| **CO2** | 3 | - | - | - | 3 | - | - | - | 3 | - | - | - | - | - |
| **CO3** | 3 | 3 | - | - | 3 | - | - | - | 3 | - | - | - | - | - |
| **CO4** | 3 | - | - | - | 3 | - | - | - | 3 | - | - | - | - | - |
| **CO5** | 3 | - | - | - | 3 | - | - | - | 3 | - | - | - | - | - |
| **AVG_CO** | 3 | 1 | - | - | 3 | - | - | - | 3 | - | - | - | - | - |

# ME162 (R20): COMMUNICATIVE ENGLISH LAB

## ME/CE 162 (R20)

| L-0 | T-0 | P-3 | M-100 | C-1.5 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

- To Improve Pronunciation.
- To Improve LSRW skills
- To Improve both Interpersonal and Intrapersonal Communication.
- To Improve Presentation skills.
- To make them to participate in any social interaction.

### COURSE OUTCOMES:

After completion of this course, students will be able to –

| | |
|---|---|
| **CO1** | Identify the sounds of English and use of stress and intonation in connected speech |
| **CO2** | Able to listen carefully to communicate effectively in cross- cultural contexts |
| **CO3** | Capable to make the students communicate in Daily life situations |
| **CO4** | Capable to read for content/ main idea. |
| **CO5** | Able to communicate confidently in oral presentations |

### LIST OF ACTIVITIES:

1) Identifying phonic sounds, listening to the sounds, practice and record the sounds from the English learning software
2) Common mispronounced words
3) Listening to the short audios and complete the tasks based on the audios
4) Listening to motivational speeches and answering the questions
5) Comprehending Spoken material in British English & American English
6) Situational Dialogues
7) Role plays
8) Reading comprehension exercises for GRE, TOEFL, GATE etc
9) Reading articles from newspaper
10) Specific reading for enhancing vocabulary
11) Vocabulary building exercises
12) Extempore
13) JAM sessions
14) Small talks
15) Oral presentations

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |
| **CO2** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |
| **CO3** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |
| **CO4** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |
| **CO5** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |
| **AVG_CO** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |

# ME163 (R20): PYTHON PROGRAMMING LAB

## ME/CE163 (R20)

| L-0 | T-0 | P-3 | M-100 | C-1.5 |
|---|---|---|---|---|

### COURSE OBJECTIVES:

This course enables the students to develop various applications using python

### COURSE OUTCOMES:

After completion of this course, students will be able to –

| | |
|---|---|
| **CO1** | Implement python programming constructs to build small to large scale applications. |
| **CO2** | Implement the problems in terms of real -world objects using OOPs technology. |
| **CO3** | Evaluate and handle the errors during runtime involved in a program |
| **CO4** | Extract and import packages for developing different solutions for real time problems. |

1) Design a Python script to convert a Binary number to Decimal number and verify if it is a Perfect number.
2) Design a Python script to determine if a given string is a Palindrome using recursion
3) Design a Python script to sort numbers specified in a text file using lists.
4) Design a Python script to determine the difference in date for given two dates in YYYY:MM:DD format(0 <= YYYY <= 9999, 1 <= MM <= 12, 1 <= DD <= 31) following the leap year rules.
5) Design a Python Script to determine the Square Root of a given number without using inbuilt functions in Python.
6) Design a Python Script to determine the time difference between two given times in HH:MM:SS format.( 0 <= HH <= 23, 0 <= MM <= 59, 0 <= SS <= 59)
7) Design a Python Script to find the value of (Sine, Cosine, Log, PI, *e* ) of a given number using infinite series of the function.
8) Design a Python Script to convert a given number to words
9) Design a Python Script to convert a given number to roman number.
10) Design a Python Script to generate the frequency count of words in a text file.
11) Design a Python Script to print a spiral pattern for a 2 dimensional matrix.
12) Design a Python Script to implement Gaussian Elimination method.
13) Design a Python script to generate statistical reports(Minimum, Maximum, Count, Average, Sum etc) on public datasets.

14) Design a Python script using the Turtle graphics library to construct a turtle bar chart representing the grades obtained by N students read from a file categorising them into distinction, first class, second class, third class and failed.

15) Design a Python script to search an element in the given list.

16) Design a Python script on *str* methods and *list* methods.

## CO-PO/PSO MAPPING MATRIX:

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

# II/IV B.Tech.
# SEMESTER I

# DEPARTMENT OF MECHANICAL ENGINEERING

# B.Tech. MECHANICAL ENGINEERING

# SEMESTER-III

## ME211 (R20): MATHEMATICS-III

## (PROBABILITY AND STATISTICS)

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

### COURSE OBJECTIVES:

To provide the students with sufficient knowledge in probability and statistics, this can be used in their respective fields.

### COURSE OUTCOMES:

| By the end of the semester, the student will be able to: | |
|---|---|
| **CO1** | Have a clear comprehension of the theory and have practical knowledge of Statistics, Measures of Central tendency, Variability, Skewness, Kurtosis, correlation, rank correlation, regression coefficients, principle of least squares. |
| **CO2** | Expected to have the clear conception of the terms Probability, random variables (discrete and continuous), probability density functions, mathematical expectation. |
| **CO3** | Grasp and able to evaluate Probability distribution - Binomial, Poisson approximation to the binomial distribution and normal distribution-their properties. |
| **CO4** | Have a clear discernment and evaluation about the Estimation- sampling distribution, point estimation, Formulation of null hypothesis, Large Sample: Tets of significance and Confidence interval. |
| **CO5** | Have capacity and evaluation of Student t-distribution, F-test, $\chi 2$ - test for goodness of fit, about test for independence of attributes. |

### UNIT - I

**Basic Probability:** Probability spaces, conditional probability, independence; Discrete random variables, Independent random variables, the multinomial distribution, Poisson approximation to the binomial distribution, infinite sequences of Bernoulli trials, sums of independent random variables; Expectation of Discrete Random Variables, Moments, Variance of a sum, Correlation coefficient, Chebyshev's Inequality.

**UNIT - II**

**Continuous and Bivariate Probability Distributions:** Continuous random variables and their properties, distribution functions and densities, normal, exponential and gamma densities. Bivariate distributions and their properties, distribution of sums and quotients, conditional densities, Bayes' rule.

**UNIT - III**

**Basic Statistics:** Measures of Central tendency: Moments, skewness and Kurtosis - Probability distributions: Binomial, Poisson and Normal - evaluation of statistical parameters for these three distributions, Correlation and regression – Rank correlation.

**UNIT - IV**

**Applied Statistics:** Curve fitting by the method of least squares- fitting of straight lines, second degree parabolas andmore general curves. Test of significance: Large sample test for single proportion, difference of proportions, single mean, difference of means, and difference of standard deviations.

**UNIT- V**

**Small samples:** Test for single mean, difference of means and correlation coefficients, test for ratio of variances - Chi-square test for goodness of fit and independence of attributes.

## TEXT / REFERENCE BOOKS:


1) E. Kreyszig, “Advanced Engineering Mathematics”, John Wiley & Sons, 2006.
2) P. G. Hoel, S. C. Port and C. J. Stone, “Introduction to Probability Theory”, Universal Book Stall, 2003.
3) S. Ross, “A First Course in Probability”, Pearson Education India, 2002.
4) W. Feller, “An Introduction to Probability Theory and its Applications”, Vol. 1, Wiley, 1968.
5) N.P. Bali and M. Goyal, “A text book of Engineering Mathematics”, Laxmi Publications, 2010.
6) B.S. Grewal, “Higher Engineering Mathematics”, Khanna Publishers, 2000.
7) T. Veerarajan, “Engineering Mathematics”, Tata McGraw-Hill, New Delhi, 2


## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 3 | 2 | | | | | | | 1 | 3 | 2 | 1 |
| **CO2** | 3 | 2 | | 3 | 2 | | | | | | | 1 | 3 | 2 | 1 |
| **CO3** | 3 | 2 | | 3 | 2 | | | | | | | 1 | 3 | 2 | 1 |
| **CO4** | 3 | 2 | | 3 | 2 | | | | | | | 1 | 3 | 2 | 1 |
| **CO5** | 3 | 1 | | 3 | 2 | | | | | | | 1 | 3 | 2 | 1 |

# ME212 (R20): STRENGTH OF MARETIALS-I

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To understand the concepts of stress, strain, and deformation in structural elements subjected to axial, torsional, and bending loads
- To learn the behavior of materials under different loading conditions and to determine their strength and stiffness
- To analyze the deflection of axially loaded members and beams and the stresses and strains in beams and to determine the shear force and bending moment diagrams
- To understand the basics of statically indeterminate structures and their analysis
- To learn about the different types of springs and their behavior under axial and torsional loads

## COURSE OUTCOMES:

1) Analyze the behavior of structural elements subjected to axial loads.
2) Determine the strength and stiffness of materials for statically indeterminate structures using flexibility and stiffness methods and also calculate the temperature stresses.
3) Calculate the stress and strain in springs under axial and torsional loads.
4) Analyze the Shear forces, moments and draw the shear force and bending moment diagrams.
5) Analyze the stresses and strains in beams, Compute principal stresses and strains for plane stress and plane strain problems using analytical & Mohrs circle methods.

**UNIT I**

**Tension, Compression and Shear** : Introduction, Normal Stress and Strain, Stress- Strain Diagrams, Elasticity and Plasticity, Linear Elasticity and Hooke's Law, Shear Stress and Strain, Allowable Stresses and Loads.(6)

**Axially Loaded Members**: Introduction, Deflections of Axially loaded Members, Displacement diagrams (6)

**UNIT II**

**Statically Indeterminate Axially Loaded Members:** Statically indeterminate structures (Flexibility method and Stiffness method) (7)

Temperature and Pre-strain effects, Strain energy of axially loaded members subjected to static load, Dynamic loading (5).

**UNIT III**

**Torsion** : Introduction, Torsion of Circular Bars, Pure Shear, Relationship between Moduli of Elasticity E and G, Transmission of power by circular shafts, Strain Energy in pure Shear and uniform Torsion for Statically determinate Members.(7)

**Springs:** Close coiled helical springs, axial load, torque, and leaf springs. (5)

**UNIT IV**

**Shear Force and Bending Moment** : Types of Beams, Shear Force and Bending Moment, Relationships between Load, Shear Force and Bending Moment, Shear Force and Bending Moment Diagrams.(12)

**UNIT V**

**Stresses in Beams:** Introduction, Normal Strains in Beams, Normal Stresses in Beams Strain Energy, Shear Stresses in Rectangular Beams, Shear Stresses in Webs of Beams with flanges.(6)

**Analysis of Stress and Strain**: Plane Stress, Principal Stresses and Maximum Shear Stress, Mohr's Circle for Plane Stress, Hooke's Law for Plane Stress, Unit Volume change, Strain Energy Density. Plane Strain, Mohr's Circle for Plane Strain. (6)

## TEXT BOOKS:

1) Mechanics of Materials by Gere and Timoshenko, C B S Publishers
2) Mechanics of Solids by Singh, Pearson Education.

## REFERENCE BOOK:

1) Strength of materials by Sadhu Singh, Khanna Publishers.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 2 | 2 | | | | | | | | | | 1 | 2 | 3 |
| **CO2** | 2 | 2 | 3 | | | | | | | | | | 1 | 2 | 3 |
| **CO3** | 1 | 1 | 2 | | | | | | | | | | 1 | 2 | 3 |
| **CO4** | 2 | 1 | 3 | | | | | | | | | | 1 | 2 | 3 |
| **CO5** | 1 | 1 | 2 | | | | | | | | | | 1 | 2 | 3 |

# ME213 (R20): MATERIAL SCIENCE & METALLURGY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To understand the concept of crystal structures and deformations.
- To know the importance of single phase diagrams, binary and ternary phase diagrams.
- Knowledge about the applications of Ferrous, Non Ferrous metals alloys and Nano materials.
- Learning about the importance of various heat treatment processes.

## COURSE OUTCOMES:

1) Students will be able to understand and analyze the structure and properties of materials, composites includes MMC, Ceramics.
2) Students will be able to apply the principles of Heat treatment processing.
3) Students will be able to analyse the principles of metallurgy to understand the behaviour of various materials
4) Learning about the latest developments in materials science and metallurgy, including the use of nanomaterials, biomaterials.
5) Understanding the principles of metallurgy, including the processing of metals.

### UNIT I

Crystallography: Classification of crystals – Bravi's lattices – Miller Indices – Packing factor in cubic systems – coordination number – crystal imperfections – crystal deformation – Slip and Twinning. (6)

Phase Diagrams: Binary phase diagrams – Phase rule – one component system, two component system, isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, concept of Ternary diagrams. (6)

### UNIT II

Heat Treatment of Steels: Iron–Iron carbide equilibrium diagram, TTT diagrams for eutectoid, hypo and hyper eutectoid steels, martensite and bainitic transformation. (6)

Heat Treatment: Annealing, normalizing, hardening, tempering, surface hardening, age hardening, austempering, martempering and hardenability concept and experimental determination. (6)

**UNIT III**

Strengthening Mechanisms: Strain hardening, solid solution strengthening, grain refinement, dispersion strengthening. (6)

Composite Materials: Properties and applications of Particulate-reinforced composites, fibre reinforced composites, Laminar composites and metal matrix composites. (6)

**UNIT – IV**

Powder Metallurgy: Powder metallurgy process, preparation of powders, characteristics of metal powders, mixing, compacting, sintering, Applications of Powder Metallurgy. Forming and shaping of plastics – Extrusion and Injection moulding. (12)

**UNIT – V**

Ferrous And Non Ferrous Materials: Composition, properties and application of ferrous and non ferrous metals and their alloys. Brief study of cast iron, steels, copper, aluminum, Nano materials – Introduction and Applications (12)

## TEXT BOOKS:

1) Introduction to Physical Metallurgy - Avner, Mc GrawHill
2) Material Science and Metallurgy - V. Raghavan, Pearson Education / PHI.
3) Material Science and Metallurgy - R.B.Choudary - Khanna Pub.

## REFERENCE BOOKS:

1) Material Science and Metallurgy - Dr.V.D.Kodgire, Everest Publishers
2) Nano materials – J.Dutta & H.Hofman
3) Manufacturing Engineering & Technology – Kalpak Jain & Schmid, Pearson / PHI

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 2 | 3 | 1 | - | - | - | 2 | 1 | 3 | 2 | 3 |
| **CO2** | 3 | 2 | 3 | 1 | 3 | 3 | - | - | 2 | - | 2 | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 1 | 2 | 1 | 2 | 2 | - | - | - | - | 1 | 3 | 2 | 2 | 2 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 3 | 1 | - | 2 | - | 2 | 2 | 3 | 2 | 2 |
| **CO5** | 3 | 1 | 1 | 1 | 2 | 2 | - | - | - | - | 3 | 3 | 3 | 3 | 1 |

# ME214 (R20): BASIC THERMODYNAMICS

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

To expose the students to the following

- Principles of classical thermodynamics and develops understanding of mass, energy, heat, work, efficiency, ideal and real thermodynamic cycles and processes.
- Demonstrate first and second laws of thermodynamics, perfect gas law, properties of real gases, and the general energy equation for closed and open systems.

## COURSE OUTCOMES:

After successful completion of course the student should be able to

**CO1:** Understand fundamental thermodynamic properties.

**CO2:** Derive and discuss the first and second laws of thermodynamics.

**CO3:** Solve problems for flow & non-flow processes using the properties and relationships of thermodynamics.

**CO4:** Know the new concept of Entropy and its importance

**CO5:** Analyze basic thermodynamic cycles.

**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, reversible and irreversible processes, factors that render a process irreversible, cycle, Zeroth law of thermodynamics, concept of temperature. (8)

**Work and Heat:** Definitions and units, system, closed system, open system, surrounding, universe, Work done at the moving boundary of a system, Work done in various non-flow processes, comparison of heat and work.(4)

**UNIT II**

**First Law of Thermodynamics for Non-Flow Systems:** First law for a system undergoing a cycle and for a change in state of system, internal energy and enthalpy, constant volume and constant pressure specific heats and their relation to internal energy and enthalpy of ideal gases. (8)

**First Law of Thermodynamics for Flow Systems*:*** Control mass and control volume, first law of thermodynamics for a control volume, Steady flow energy equation and its Application to engineering equipment. (4)

**UNIT III**

**Second Law of Thermodynamics:** Limitations of first law, PMM of first kind**,** Heat engines and Refrigerators, Statements of Second law, PMM of second kind, Carnot cycle and Carnot theorems, Thermodynamic temperature scale. (8)

**Pure Substance:** Definition**,** process of steam generation, P-v, T-s and h-s diagrams, Properties of saturated and superheated steam, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction (4)

**UNIT IV**

**Entropy:** Inequality of Clausius, 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, Availability, Maximum work. (12)

**UNIT V**

**Gas Power Cycles:** Air standard Carnot cycle, Otto, Diesel, Dual Combustion cycles, Sterling Cycle, Atkinson Cycle, Ericsson Cycle, Lenoir Cycle, Brayton Cycle – Description and representation on P–V and T-S diagram, Thermal Efficiency, Mean Effective Pressures on Air standard basis – comparison of Cycles.(12)

## TEXT BOOKS:

1) Engineering Thermodynamics- P.K.Nag, TMH, New Delhi.
2) Thermal Science and Engineering- D.S.kumar, S.K.Katariapubl, New Delhi.
3) Thermodynamics—Rajput, LaxmiPubl, New Delhi.

## REFERENCE BOOKS:

1) Fundamentals of Engineering Thermodynamics-Rathakrishnan-PHI, New Delhi.
2) Thermodynamics -- J.P.Holman, MGH, New York.

**Note: Use of Steam Tables is permitted in University Examinations**

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | - | - | - | 1 | - | - | - | 2 | - | - |
| **CO2** | 2 | 3 | 1 | - | - | - | - | - | - | 1 | - | - |
| **CO3** | 2 | 3 | - | - | - | - | - | - | - | 1 | - | - |
| **CO4** | 3 | 2 | - | - | - | - | - | - | - | 1 | - | - |
| **CO5** | 1 | 3 | 2 | 1 | - | - | - | - | - | 1 | - | - |

# ME215 (R20): MANUFACTURING PROCESSES

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To understanding about the primary manufacturing processes such as casting, joining, forming process.
- To understand the concept of different welding methods like TIG, MIG, MMAW and GTAW and also soldering and brazing process and its defects.
- To understand the basic concepts of gating design.
- To understanding about the different metal forming process
- To understanding about the different nonconventional machine process

## COURSE OUTCOMES:

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

1) Select appropriate Manufacturing Processing to manufacture any component.
2) Interpret foundry practices like pattern making, mold making, Core making and Inspection of defects.
3) Differentiate various metal forming processes such as Hot and Cold Working, and Drawing Processes
4) Different welding, soldering and brazing process.
5) Understand the rolling and sheet metal process.

**UNIT I**

**Metal Casting:** Introduction, advantages of Casting method, pattern: types, materials and allowances. Sand moulding procedure, Moulding materials and equipment. Preparation, control and testing of mouldingsands. Cores, Cupola: Description, operation and zones. (12)

**UNIT- II**

**Gating Design**: Design Considerations

**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.(12)

**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:** Types of rolling mills, roll passes

**Forging:** Types, description and types of forging, defects in forged parts.

**Extrusion:** Classification, description and application of extrusion process Tube making, Swaging Spinning, Coining, Embossing and Wire drawing

Explosive forming and electro hydraulic forming.(12)

**UNIT- V**

Additive manufacturing: Rapid prototyping and rapid tooling(5)

**Unconventional Machining Processes:** Abrasive Jet Machining, Water Jet Machining, Abrasive Water Jet Machining, Ultrasonic Machining, principles and process parameters, Laser Beam Machining (LBM), Plasma Arc Machining (PAM) and Electron Beam Machining (7)

## TEXT BOOKS:

1) Manufacturing Technology-Vol- I by PN Rao, TMH.
2) Workshop Technology Vol.1 by S.K.Hazra Chowdary. Khanna Publishers.
3) A course in Work shop technology, Vol-I by B.S.Raghuvanshi, Dhanpatrai & Sons.

## REFERENCE BOOKS:

1) Welding Technology by Little, TMH
2) Principles of Metal Casting by Heine, Loper, Rosenthal, TMH.
3) Manufacturing Engineering & Technology, Kalpakjain, Pearson Education / PHI.

## CO-PO/PSO MAPPING MATRIX:

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 2 | 2 | 1 | 2 | 1 | | | | | | | 2 | 2 | 1 |
| **CO2** | 2 | 1 | 1 | 2 | 2 | 1 | | | | | | | 2 | 2 | 1 |
| **CO3** | 1 | 2 | 1 | 2 | 2 | 1 | | | | | | | 2 | 2 | 1 |
| **CO4** | 2 | 1 | 2 | 2 | 2 | 1 | | | | | | | 2 | 2 | 1 |
| **CO5** | 1 | 2 | 2 | 2 | 2 | 1 | | | | | | | 2 | 2 | 1 |

# ME216 (R20): CONSTITUTION OF INDIA

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **4 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OUTCOMES:

After completion of this course, students will be able to

1) Understand the historical context and sources of the Indian Constitution, including the Preamble, fundamental rights and duties, an directive principles of state policy.
2) Analyze the structure of the Indian Union government and its administration, including federalism, the role of the President and Prime Minister, the Cabinet, Lok Sabha, Rajya Sabha, and the powers and functions of the Supreme Court and High Court.
3) Examine the state government and its administration, including the role of the Governor Chief Minister and Council of Ministers, State Secretariat, and the organization and functions of district and municipal administrations.
4) Evaluate the importance of grass root democracy through an understanding of the functions and roles of Pachayati Raj, Zila Panchayat, and elected and appointed officials at the village, block and district levels.
5) Develop an understanding of the role and functions of the Election Commission, including the Chief Election Commissioner and Election Commissionerate, the State Election Commission, and the Commissions for the welfare of SC/ST/OBC and women.

**UNIT-I**

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

**UNIT-II**

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

**UNIT-III**

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

**UNIT-IV**

A Local Administration - District's Administration Head - Role and Importance, Municipalities - Mayor and role of Elected Representative - CEO of Municipal Corporation PachayatiRaj: Functions PRI: ZilaPanchayat, Elected officials and their roles, CEO ZilaPanchayat: Block level Organizational Hierarchy - (Different departments), Village level - Role of Elected and Appointed officials - Importance of grass root democracy

Evaluate Zillapanchayat block level organisation

**UNIT-V**

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

## REFERENCE BOOKS:


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


## E-RESOURCES:

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

## CO-PO/PSO MAPPING MATRIX:

| COs | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | 1 | - | - | 2 | - | 1 | - | - | - | 2 | 3 |
| **CO2** | - | 3 | 2 | - | 2 | 3 | - | 2 | 3 | - | - | - | 1 | 2 |
| **CO3** | - | - | - | 1 | 3 | - | 1 | - | - | 2 | - | - | 2 | 1 |
| **CO4** | 3 | - | 2 | - | - | 2 | - | 2 | 2 | - | 2 | - | 3 | 2 |
| **CO5** | 3 | 1 | 3 | - | - | - | 3 | - | 2 | 1 | - | 1 | 3 | 2 |

# ME251 (R20): MACHINE DRAWING LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

The student will acquire knowledge in national and International standards while drawing machine components students will also familiarize in drawing assembly, orthographic and sectional views of various machine components.

## COURSE OUTCOMES:

CO1: Develop and interpret production drawing for various machine elements

CO2: Prepare different components using Carpentry, Tin-smithy trade and apply basic electrical engineering knowledge for house wiring practice.

CO3: Develop 3D part modelling and assembling of machine elements.

CO4: Prepare different components using various manufacturing techniques and perform various machining operations.

CO5: Develop 3D surface modeling and sheet metal drawings.

## MACHINE DRAWING:

1) **Sectional views :** Introduction, full & half section
2) **Screwed fasteners:** Screw thread nomenclature – types & classification of screw threads, Square & Hexagonal headed bolted joints.
3) **Keys, Cotters and Pin joints** : Saddle & Sunk Keys, Cotter Joint with sleeve ,Knuckle Joint
4) **Assembly Drawings** : Stuffing Box , Screw Jack , Eccentric .

## TEXT BOOK:

1) Machine Drawing by K.L.Narayana, P.Kannaiah & K.Venkata Reddy

## REFERENCE BOOK:

1) Machine Drawing by K.R. Gopala Krishnan

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | | | | | | | | | 3 | 2 | 1 |
| CO2 | 3 | 1 | 2 | | | | | | | | | | 2 | 3 | 1 |
| CO3 | 2 | 3 | 3 | | | | | | | | | | 2 | 3 | 2 |
| CO4 | 2 | 3 | 3 | | | | | | | | | | 2 | 3 | 2 |

# ME252 (R20): BASIC MANUFACTURING PROCESSES LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To provide an understanding of advanced manufacturing methods
- To get an idea of the dimensional & form accuracy of products
- To cultivate the ability to develop and implement new improved manufacturing processesresulting in creation and distribution of value in engineering applications
- To impart knowledge about the significance of controlling process parameters for the optimal performance for newly developed engineering materials used in industries.

## COURSE OUTCOMES:

Course outcomes: After the successful completion of the course, students are able to

1) To train the students how to prepare the patterns.
2) Select appropriate Manufacturing Processing to manufacture any component
3) Gain knowledge of various machine tools and its operations.
4) To apply some of the manufactures process directly in the industry for preparation of complicated jobs.
5) The student will be trained to implement similar features in preparation of jobs can be extended to implement in the preparation of complicated jobs

**PATTERN MAKING:** Solid pattern, Split pattern .

**MOULDING:** Stepped cone pulley, Hand wheel, Bush.

**FITTING:** Six Standard Exercises

**TURNING:** Plain, Step and Taper turning, Right-hand and Left-hand threads, Eccentric turning, Knurling and contour turning.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | | | | | | | | | | 1 | 2 | 1 |
| **CO2** | 3 | 3 | 3 | | | | | | | | | | 1 | 3 | 3 |
| **CO3** | 2 | 3 | 3 | | | | | | | | | | 1 | 3 | 3 |
| **CO4** | 2 | 3 | 3 | | | | | | | | | | 1 | 3 | 3 |

# ME253 (R20): STRENGTH OF MATERIALS LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To provide practical exposure to the concepts of strength of materials and aterial testing techniques
- To familiarize students with various testing equipment and procedures used in the field of strength of materials
- To develop skills in conducting experiments and analyzing the experimental data
- To understand the behavior of different materials under various loading conditions
- To determine the mechanical properties and characteristics of materials through laboratory experiments

## COURSE OUTCOMES:

1) Apply experimental techniques to study the behavior of materials.
2) Analyze and interpret experimental data to determine material properties.
3) Conduct tests to evaluate the mechanical properties of materials.
4) Demonstrate skills in using testing equipment and techniques.
5) Apply knowledge of material behavior to practical situations.

**NOTE: A MINIMUM OF 10 EXPERIMENTS SHALL BE CONDUCTED DONE AND RECORD.**

1) To study the stress – strain characteristics of mild steel bars by UTM.
2) To find young's modulus of the given material (steel or wood) by conducting bending test on simply supported beam.
3) To find modulus of rigidity by conducting torsion test on solid circular shaft.
4) To find the hardness of the given material by Brinnel's Hardness Tester.
5) To determine the hardness of the given material by Vicker's / Rockwell hardnesstester.
6) To find impact resistance of the given material by conducting Charpy / Izod test on impact testing machine.
7) To determine the ultimate shear strength of steel rod in single and double shear.
8) To determine the modulus of rigidity of the spring.
9) Compression test on wood.
11) To determine fatigue strength of Mild steel.
12) To determine stress concentration factor.
13). Compression test on concrete Cubes.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | 2 | | | | | | | | | | 1 | 2 | |
| **CO2** | 1 | | 2 | | | | | | | | | | 1 | 2 | |
| **CO3** | 1 | 2 | 2 | | | | | | | | | | 1 | 2 | |
| **CO4** | 2 | | 2 | | | | | | | | | | 1 | 2 | |
| **CO5** | 1 | | 2 | | | | | | | | | | 1 | 2 | |

# ME254 (R20): CATIA 2D DRAFTING

## (SKILL COURSE)

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

### COURSE OBJECTIVES:

- To enhance the student's knowledge and skills in engineering drawing.
- To introduce various commands in CATIA to draw the geometric entities and to create 2D wire frame models.
- To introduce various commands in CATIA to draw the geometric entities and to create 3D wire frame models.
- To create geometrical model of simple solids, machines & machine parts.
- To interpret viewpoints and view ports, viewpoint coordinates and views displayed and develop computer aided solid models with isometric and orthographic projections.

### COURSE OUTCOMES:

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

1) Understand skills in engineering drawing.
2) Utilize various commands in CATIA to draw the geometric entities and to create 2D wire frame models.
3) Interpret various commands in CATIA to draw the geometric entities and to create 3D wireframe models.
4) Construct geometrical model of simple solids, machines & machine parts.
5) Understand view points and view ports, view point coordinates and views displayed and develop computer aided solid models with isometric and orthographic projections.

### SKETCHER

1) Introduction to CATIA, History, Basics, GUI, Use of mouse buttons, Sketcher, on straints, profile, setting workbench
2) Standard toolbar, how to open sketcher, sketch details and important toolbar for sketch
3) Profile toolbar, Types of constraints, constraint application, and constraint colour
4) Sketch constraint, view toolbar, Operation toolbar
5) Specification tree use, selecting toolbars
6) Sketch toolbar, Visualisation toolbar
7) Toolbar setting, plane size setting, graphics properties toolbar.

8) 3D introduction, important toolbar
9) Sketch based features toolbar

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **2** | **3** | **2** | **1** | **2** | **2** | | | **3** | **2** | | **1** | **3** | **2** | **1** |
| **CO2** | **2** | **2** | **2** | **2** | **2** | **2** | | | **3** | **2** | | **2** | **2** | **2** | **2** |
| **CO3** | **2** | **3** | **2** | **2** | **2** | **2** | | | **3** | **2** | | **2** | **2** | **1** | **2** |
| **CO4** | **2** | **3** | **3** | **1** | **2** | **2** | | | **3** | **2** | | **3** | **3** | **2** | **3** |
| **CO5** | **2** | **3** | **2** | **1** | **2** | **2** | | | **3** | **2** | | **2** | **2** | **3** | **2** |

# II/IV B.Tech.

# SEMESTER II

# DEPARTMENT OF MECHANICAL ENGINEERING

# B.Tech. MECHANICAL ENGINEERING

# SEMESTER-IV

## ME221 (R20): STRENGTH OF MATERIALS- II

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

### COURSE OBJECTIVES:

- To understand the behavior of beams and columns under different loading conditions
- To analyze the deflection of beams using differential equations and various methods such as moment area method and Macaulay's method
- To study the buckling and stability of columns and analyze their behavior under eccentric axial loads and to analyze statically indeterminate beams and continuous beams
- To study the design and analysis of pressure vessels, including thin spherical and cylindrical vessels, thick cylinders, and compound cylinders and to understand the behavior of curved beams and analyze the stresses in beams with small and large initial curvature.
- To study the concept of shear center and analyze the shear flow in various beam cross-sections and to understand the concept of centrifugal stresses and analyze the stresses in rotating rings and discs.

### COURSE OUTCOMES:

1) Apply analytical techniques to analyze the behavior of beams and Demonstrate skills in using differential equations and different methods to determine deflections and analyze structures.
2) Apply analytical techniques to analyze the behavior columns, and pressure vessels.
3) Analyze statically indeterminate beams and continuous beams using appropriate methods.
4) Apply theoretical concepts to analyze the behavior of curved beams and determine stresses in beams with different initial curvatures and analyze the design and behavior of pressure vessels under different loading conditions.
5) Apply the concept of shear center to analyze the shear flow in various beam cross-sections and analyze the centrifugal stresses**.**

### UNIT I

**Deflections of Beams** : Introduction, Differential Equations of the Deflection Curve, Deflections by Integration of the Bending Moment Equation, Deflections by integration of the Shear Force and Load equations. Introduction to Moment Area Method, Macaulay's Method.

**UNIT II**

**Columns :**Buckling and Stability, Columns with Pinned ends, Columns with other support conditions, Limitations of Euler's Formula, Rankine's Formula, Columns with eccentric Axial Loads, Secant formula.

**UNIT III**

**Statically Indeterminate Beams:** Statically indeterminate Beams, Analysis by the differential equations of the Deflection curve, Moment Area Method.

**Continuous Beams:** Clapeyron's theorem of three moments, Beams with constant and varying moments of inertia.

**UNIT IV**

**Pressure Vessels:** Thin Spherical and Cylindrical Pressure Vessels [Biaxial Stresses], Thick Cylinders: Lame's theory, Radial Deflection, Compound Cylinders.

**Curved Beams:** Stresses in Beams of small and large initial curvature, The Winkler-Bach theory, Stresses in Crane Hook and C-Clamp with Rectangular, Circular and Trapezoidal cross-sections. (10)

**UNIT V**

**Shear Centre:** Bending Axis and Shear Centre, Position of Shear Centre, Shear flow,

Shear Centre of Channel section, Angle section, T- section and I- section.

**Centrifugal Stresses:** Introduction, Rotating Ring, Rotating Disc, Rotating Disc of uniform strength.

## TEXT BOOKS:

1) Mechanics of Materials by Gere and Timoshenko, CBS Publishers& Distributors.
2) Mechanics of Solids by Singh, Pearson Education.

## REFERENCE BOOKS:

1) Strength of materials by Sadhu Singh, Khanna Publishers
2) Advanced Solid Mechanics by L.S. Srinath

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| CO2 | 1 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| CO3 | 1 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| CO4 | 1 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| CO5 | 1 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |

# ME222 (R20): KINEMATICS OF MACHINES

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To study the relative motion, velocity, and accelerations of the various elements in a mechanism.
- To understand the principles of dynamic motion and their applications.
- To design Cams & followers and Gear Trains.

## COURSE OUTCOMES:

CO1. Acquire knowledge on basic mechanisms

CO2. Analyse the velocity, acceleration and mechanisms with plan body motion.

CO3. Creating an On-line mechanism with hook joint.

CO4. Apply the knowledge to analyse the motion of cams and followers

CO5. Evaluate and Study the higher pairs Mechanisms.

### UNIT I

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

**Instantaneous centre**: Notation, Number of I - Centres, Kennedy's theorem, Locating I - Centres, Angular velocity by I - Centre Method.

### 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.

### UNIT III

**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.

**UNIT IV**

**Cams** Definitions of cam and followers - their uses - types of followers and cams - types of follower motion - uniform velocity, simple harmonic motion and uniform acceleration and retardation. Maximum velocity and maximum acceleration during outward and return strokes in the above three cases.

Analysis of motion of followers: Tangent cam with Roller follower - circular arc cam with straight, concave and convex flanks.

**UNIT V**

**Gears:** Introduction, Classification gear 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, Interference between Rack and Pinion, Undercutting, Comparison of Cycloidal and Involute tooth forms.

**Gear Trains:** Introduction, simple Gear Train, Compound Gear Train, Reverted Gear train, Planetary or Epicyclic Gear Train, Analysis of Epicyclic Gear Train, Torques in Epicyclic Trains. Tabular method.

## TEXT BOOKS:

1) Theory of Machines of by S.S.Rattan. TMH.
2) Theory of Mechanisms and Machines by C.S.Sharma, Kamlesh Purohit, PHI

## REFERENCE BOOKS:

1) Theory of Mechanisms and Machines by Ghosh and Mallik
2) Mechanism and Machine Theory by J.E. Shigley, MGH

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 2 | 1 |
| **CO2** | 3 | 1 | 2 | | | | | | | | | 2 | 2 | 3 | 1 |
| **CO3** | 2 | 3 | 3 | | | | | | | | | 2 | 2 | 3 | 2 |
| **CO4** | 2 | 3 | 3 | | | | | | | | | 2 | 2 | 3 | 2 |
| **CO5** | 3 | 1 | 3 | | | | | | | | | 1 | 2 | 3 | 1 |

# ME223 (R20): FLUID MECHANICS & HYDRUALIC MACHINES

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To give fundamental knowledge of fluid, its properties and behavior under various conditions of internal and external flows.
- To develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.
- To impart the knowledge of impact of jets.
- To impart the knowledge on pumps and turbines.
- To introduce the concepts of the working and design aspects of hydraulic machines like turbines and pumps and their applications.

## COURSE OUTCOMES:

1) Understanding of the basic principles of fluid mechanics, including continuity, Bernoulli's equation, Nervier-Stokes equation, and Euler's equation.
2) Knowledge of different types of flow, such as laminar and turbulent flow, and should be able to analyze and predict the behavior of fluids in different situations.
3) Ability to analyze fluid flow to apply the principles of fluid mechanics to analyze and solve problems related to fluid flow in pipes, channels, and other systems.
4) To understand the principles and operation of hydraulic machines, including pumps, turbines, and compressors.
5) Ability to analyze hydraulic systems by using mathematical models and simulation tools to analyze and predict the behavior of hydraulic systems, including their performance and efficiency and Evaluating of dimensional analysis to derive and interpret relationships between different physical variables in fluid mechanics.

## 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. (5)

**Fluid Statics:** Pressure, variation of pressure in fluid, measurement of pressure – simple and differential manometers, pressure head, Pascal's law, Total pressure and center of pressure on submerged plates, Buoyancy and Metacentric height. (7)

**UNIT II**

**Fluid Kinematics:** Type of fluid flow, flow patterns, Rotation and irrotational flow, velocity potential, stream function, flow net, continuity equation & Bernoulli's equation (4)

**Fluid Dynamics:** Introduction, Euler's equation of motion, Bernoulli's equation, Pitot tube, Venturimeter, Orifice meter, orifice-various coefficients of an orifice (6)

**Impulse Momentum Equation:** Impulse momentum Principle, Equation and Application, Force on pipe bend. (2)

**UNIT Ill**

**Flow Through Pipes:** Laws of fluid friction, minor losses, hydraulic gradient line, total energy line, pipes in series and parallel, water hammer (7)

**Impact Of Jets:** Introduction, Force exerted by a fluid jet on stationary and moving flat plate and curved vanes, flow over radial curved vanes.(5)

**UNIT IV**

**Hydraulic Turbines:** Elements of hydro-electric power plants: Heads and Efficiencies of Pelton wheel, Francis turbine and Kaplan turbine. (6)

**Performance Of Turbines:** Performance under unit quantities, Performance under specific conditions - Specific speed, Performance characteristic curves.(4)

**Pumps**: Working principles of Centrifugal and Reciprocating Pumps. (2)

**UNIT V**

**Dimensional Analysis & Model Similitude**: Introduction, Buckingham's Pi theorem, Types of similarities, Force ratios, Dimensionless numbers, Model Laws-Reynolds and Froude law, Types of models, Scale effect.(Qualitative treatment only) (7)

**Boundary Layer Concepts:** Introduction, boundary layer thickness, displacement thickness, momentum thickness, energy thickness, boundary layer growth on a flat plate, separation of boundary layer. (5)

## TEXT BOOKS:

1) Hydraulics and Fluid Mechanics --P.N.Modi & S.M. Seth,
2) Fluid Mechanics & Fluid Power Engineering - D.S.Kumar, SK Kataria & sons, New Delhi.
3) Fluid Mechanics and Fluid machines – Agarwal, TMH.

## REFERENCE BOOKS:

1) Fluid Mechanics & Hydraulic Machines - R.K.Bansal
2) Fluid mechanics including Hydraulic machines - A.K.Jain.
3) Fluid Mechanics-K.L.Kumar

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 1 | | | | | | 1 | 2 | 2 | 2 |
| CO2 | 2 | 3 | 2 | 2 | 2 | 1 | | | | | | 2 | 2 | 2 | 2 |
| CO3 | 2 | 3 | 2 | 3 | 2 | 1 | | | | | | 1 | 2 | 2 | 2 |
| CO4 | 3 | 2 | 3 | 2 | 2 | 1 | | | | | | 2 | 2 | 2 | 2 |
| CO5 | 3 | 2 | 2 | 2 | 2 | 1 | | | | | | 2 | 2 | 2 | 2 |

# ME224 (R20): APPLIED THERMODYNAMICS

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To enable the student to understand what is a pure substance what are its properties and know the working of different high pressure boilers, mountings and accessories & steam power plant and methods of improving efficiency of plant
- To enable the students to understand working of various nozzles and calculate the exit
- Velocity and areas of nozzle and the working principles of steam condensers and their analysis.
- To enable the students to understand the basic principles of steamturbines and analysis of bot him pulse and reaction turbines.
- To enable the student to understand the basic principles of refrigeration and air conditioning systems and to understand the various Psychrometric processes and summer and winter air conditioning systems.

## COURSE OUTCOMES:

1) Able to estimate the various properties of Steam by using the steam tables, Mollier chart and able to understand the working of high pressure boilers and their mountings and accessories and also able to understand the working principle of steam power plant and variable affecting it's performance and methods to improve it's performance.
2) Able to estimate the maximum discharge from steam nozzles and areas of nozzle at various locations. Able to estimate the vacuum efficiency and condenser efficiency and cooling water requirements of steam condensers.
3) Able to estimate the blade angles, various velocities and efficiencies by using velocity diagram and analytical methods for both impulse and reaction turbines.
4) Able to understand the working of air refrigeration and vapour compression refrigeration systems and Fundamentals.

## UNIT I

**Vapor Power Cycles:** Rankine cycle, Effect of pressure and temperature on the Rankine cycle, reheat cycle, regenerative cycle. (8)

**Steam Boilers:** Function, classification, working of Babcock and Wilcox boiler, Mountings & Accessories.(4)

**UNIT II**

**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. (7)

**Steam Condensers:**

Jet and Surface condensers, condenser vacuum and vacuum efficiency, Condenser efficiency, Thermodynamic analysis, Air pumps, Capacity of air extraction pump. (5)

**UNIT III**

**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.(12)

**UNIT IV**

**Refrigeration:** Need for Refrigeration, Definitions, Methods of refrigeration, Working of Refrigerator& Heat pump, Bell - Coleman cycle, Refrigerating effect, COP , vapor compression refrigeration system, influence of various parameters on cycle performance, Vapor absorption refrigeration cycle. (12)

**UNIT V**

**Psychrometry and Air Conditioning:** -Introduction, Psychrometricproperties, Psychrometric chart, Psychrometric processes, Applications of Psychrometric processes. Types of Air conditioning systems.(12)

## TEXT BOOKS:

1) Treatise on Heat Engineering-V.P.Vasandani and D.S.Kumar, Metropolitan Book co, New Delhi.
2) Thermal Engineering ---Rajput, LaxmiPubl, New Delhi.
3) Thermal Science and Engineering- D.S.kumar, S.K.kataria Publ, New Delhi.

## REFERENCE BOOKS:

1) Engineering Thermodynamics--Cengel and Boles, TMH.
2) Refrigeration and Air Conditioning - C.P. Arora, TMH.
3) Engineering Thermodynamics-Achuthan, PHI, New Delhi.

**Note: Use of Steam Tables and Refrigeration and Air-Conditioning Tables is permitted in University Examinations.**

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | | | | | | | | | | 2 | 2 | 1 |
| CO2 | 2 | 3 | 2 | | | | | | | | | | 2 | 2 | 3 |
| CO3 | 2 | 3 | 2 | | | | | | | | | | 1 | 2 | 3 |
| CO4 | 3 | 2 | 3 | | | | | | | | | | 2 | 2 | 2 |
| CO5 | 3 | 2 | 2 | | | | | | | | | | 1 | 2 | 2 |

# ME225 (R20): PROFESSIONAL ETHICS AND HUMAN VALUES

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **4 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OUTCOMES:

After completion of this course, students will be able to

1) Understand and appreciate the importance of integrity, work ethic, and service learning in professional engineering practice.
2) Develop an awareness of the moral issues and ethical dilemmas that arise in engineering, and be able to apply ethical theories to real-world situations recognize the social and environmental impacts of engineering, and understand the responsibility that engineers have to society and the environment.
3) Be able to analyze and assess risks and benefits associated with engineering projects, and make informed decisions that prioritize safety and social responsibility.
4) Develop the skills to communicate effectively with colleagues, clients, and other stakeholders, and to work collaboratively and respectfully in team settings.

**UNIT – I**

**Human Values:** Morals, Values and Ethics – Integrity – Work Ethic – Service Learning – Civic Virtue – Respect for Others – Living Peacefully – caring – Sharing – Honesty – Courage – Valuing Time – Co-operation – Commitment – Empathy – Self-Confidence – Character – Spirituality.

**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 – Consensus and Controversy – Professions and Professionalism – Professional Ideals and Virtues – Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories.

**UNIT – III**

**Engineering as Social Experimentation:** Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.

**UNIT - IV**

**Safety, Responsibility and Rights:** Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and reducing risk.

Collegiality and Loyalty – Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) - Discrimination

**UNIT – V**

**Global Issues:** Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Sample Code of Ethics like ASME, ASCE, IEEE, Institution of Engineers (India), Indian Institute of Materials Management, Institution of electronics and telecommunication engineers (ISTE), India, etc.

## TEXT BOOKS:

1) R.S. Naagarazan "A Textbook on Professional ethics and Human Values", New Age International Publihers, 2006.
2) Govindarajan. M, Natarajan. S, Senthilkumar. V.S, "Engineering Ethics", Prentice Hall of India, 2004.

## REFERENCE BOOKS:

1) Charles D Fleddermann, "Engineering Ethics", Prentice Hall, New Jersey, 2004 (Indian Reprint).
2) Charles E Harris, Michael S Pritchard and Michael J Rabins, "Engineering Ethics Concepts and Cases", Thompson Learning, United States, 2000 (Indian Reprint now available).
3) John R Boatright, "Ethics and the Conduct of Business", Pearson Education, New Delhi, 2003.
4) Edmund G Seebauer and Robert L Barry, "Fundamentals of Ethics for Scientists and Engineers", Oxford University Press, Oxford, 2001.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 1 | 2 | 3 | 3 | - | - | 2 | - | - | - | 2 | 3 | 1 |
| **CO2** | - | 2 | - | 2 | - | - | - | 3 | - | - | - | 1 | 3 | 2 |
| **CO3** | 2 | 3 | - | 3 | 3 | - | - | 3 | - | - | - | 2 | 2 | 1 |
| **CO4** | 2 | 2 | 2 | 2 | - | - | - | - | - | - | 3 | 2 | 2 | 2 |
| **CO5** | 3 | 2 | 2 | 3 | 1 | - | - | 2 | - | 1 | - | 2 | 2 | 1 |

# ME261 (R20): FLUID MECHANICS & HYDRAULIC MACHINES LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To make the student understand about the friction of the pipes
- To teach the students about minor loses due to pipe bend sudden contraction and sudden expansion
- To understand about the pipes and turbines
- To make the student understand about the different types of flows and discharges
- To teach the students about impact of jets.

## COURSE OUTCOMES:

At the end of course the students will be able to:

1) Understanding of basics of fluids
2) Gaining knowledge to calculate the coefficient of discharge.
3) Understanding concepts of different alternative fuels used for SI and CI engines.
4) Having knowledge about offrictionofpipes and losses
5) Gaining knowledge of Performancestudies on pumps and turbines

**Note: A minimum of 10 experiments are to be performed**

1) Verification of Bernoulli's theorem
2) Venturimeter & Orificemeter: Determination of coefficient of discharge
3) Orifices: Determination of coefficient of discharge by steady and unsteady flow methods.
4) Mouthpieces: Determination of coefficient of discharge by steady and unsteady flow methods.
5) Characterization of laminar and turbulent flows by Reynolds apparatus
6) Determination of friction factor of pipes
7) Determination of loss of head in pipes due to bends, sudden contractions and sudden expansion.
8) Measurement of force due to impact of jets on vanes of different types
9) Performance studies on Pelton turbine
10) Performance studies on Francis turbine / Kaplan turbine
11) Performance studies on single stage centrifugal pump
12) Performance studies on Reciprocating pump.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 2 | 2 |
| CO2 | 3 | 2 | 3 | 2 | 2 | | | | | | | | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 2 | 2 |
| CO4 | 2 | 2 | 3 | 2 | 3 | | | | | | | | 3 | 2 | 3 |
| CO5 | 2 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 3 | 2 |

# ME262 (R20): MODELING LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

This course focuses on both traditional drafting techniques and computer aided drafting. Further, the course aims at enabling the students to understand and apply national and international standards while drawing machine component, and familiarize them in drawing various machine components, drafting the assembly and part drawings of machine components.

## COURSE OUTCOMES:

1) To understand various evaluation criteria's for CAD system and need of graphics standard.
2) To represent different curves and surfaces of geometric models mathematically.
3) To represent solid models using different solid represent schemes
4) To recognize and apply various data exchange formats in geometric modeling and also will be able to apply finite element modeling and mechanical assembly concepts in design applications
5) To apply concepts of geometric modeling in designing using CAD tools.3D modelling using any of the modeling packages like CATIA, Creo, Uni-Graphics, Solid Works, Ideas, Auto Desk Inventor etc.

## LIST OF MODULES TO BE COVERED:

SKETCHER PART MODELLING WIREFRAME MODELLING
SURFACE MODELING ASSEMBLY MODELLING DRAFTING

## WITH EXAMPLES OF ASSEMBLY DRAWINGS.

1) Screw Jack. 2) Stuffing Box. 3) Eccentric.

Parts and Assemblies can be choosen from

1) A Text book of "Machine Drawing" by K. L. Narayana, P. Kannaiah, K. Venkata Reddy.
2) Pro/Engineer (CREO Parametric 2.0) for Engineers and Designers, by Prabhakar S.T. Dream Tech Press

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 | 2 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 2 | 3 | 3 |
| CO3 | 3 | 3 | 2 | | | | | | | | | | 2 | 3 | 2 |
| CO4 | 3 | 3 | 2 | | | | | | | | | | 2 | 3 | 2 |
| CO5 | 3 | 3 | 2 | | | | | | | | | | 2 | 3 | 1 |

# ME263 (R20): ADVANCED ENGLISH COMMUNICATION SKILLS LAB

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

The main course objective of **Advanced English Communication Skills Lab** is to develop the student's Non-Verbal Communication, Cognitive and Poignant Skills, Interview Skills, Employability and Interpersonal skills, which relate to situations in the work place. The skills imparted to the learners are body language, leadership, time management, team management, assertive skills, group discussions, interview techniques and positive work ethics ...etc.

The methodology includes Interactive sessions, Role Play, Team Work/Group Work/Pair Work and Peer Evaluation. The emphasis is on learning by doing to improve the learners' life skills.

## COURSE OUTCOMES:

| | |
|---|---|
| **CO1** | To realize the importance of communication skills in job arena. To enhance the students ability to communicate |
| **CO2** | Able to learn vocabulary for GRE, TOEFL, IELTS,IES etc |
| **CO3** | Capable to participate in all recruitment procedures |
| **CO4** | Able to communicate effectively over a phone and proficient to demonstrate telephoning skills |
| **CO5** | Able to describe procedures and improves analytical thinking |
| **CO6** | Able to know the importance of personality development |

**Module-l Communication Skills**

**I. Verbal**

a) Types of Communication
b) Barriers to Communication
c) Strategies for effective communication

**II. Nonverbal Skills -**

a) Body Language – Voluntary and Involuntary
b) Kinesics
c) Facial Expressions

a) Proxemics
b) Oculesics
c) Haptics and Chronemics

**Module-2: Advanced Vocabulary**

a) Word list (GRE & TOEFL related)
b) One Word Substitutes
c) Idioms

**Module-3: Employability Skills (Ref: 6)**

a) Interview Skills
b) Group Discussion
c) Resume Writing

**Module-4: Telephonic Skills**

a) Formal &Informal interaction
b) Receiving Messages & Complaints
c) Tone modulation

**Module-5: Descriptions**

a) Process Description
b) Pictures
c) Narration

**Module-6: Behavioural Skills**

a) Emotional Intelligence
b) Positive Attitude
c) Team Work
d) Organization Skills

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 | PS O4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | - | - | - | 1 | 2 | 1 | 1 | | - | - | - | 3 | 1 | - |
| **CO2** | 1 | 1 | - | - | - | | 1 | 1 | - | 1 | - | 1 | - | 3 | - | - |
| **CO3** | 2 | 1 | - | - | - | 1 | 1 | - | - | | 1 | - | - | 3 | 1 | - |
| **CO4** | 2 | 1 | - | - | - | 1 | 1 | - | - | 1 | 1 | - | - | 3 | 1 | - |
| **CO5** | 2 | 2 | - | - | - | 2 | 1 | 1 | 1 | | | 1 | - | 3 | - | - |

# ME264 (R20): MATLAB FOR MECHANICAL ENGINEERING

## (SKILL COURSE)

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

### COURSE OBJECTIVES:

- To introduce students to MATLAB and its application in engineering problem solving.
- To familiarize students with MATLAB syntax, commands, and programming techniques.
- To develop skills in using MATLAB to perform arithmetic, logical, and Boolean operations.
- To enable students to analyze and manipulate matrices and vectors using MATLAB.
- To demonstrate the use of conditional statements and loops in MATLAB programming.
- To explore the capabilities of MATLAB for data visualization and plotting.
- To understand and implement regression and polynomial functions in MATLAB.

### COURSE OUTCOMES:

1) Understand the basics of MATLAB and its applications in engineering Problem solving
2) Write MATLAB commands and scripts to perform arithmetic, logical, and Boolean operations.
3) Utilize MATLAB to manipulate matrices and perform vector operations .Implement conditional statements and repetition loops in MATL programs.
4) Visualize data and generate plots using MATLAB's plotting functions and apply Regression and polynomial functions in MATLAB to analyze and model data.

### ACTIVITES:

1) Introduction to MATLAB
2) MATLAB Syntax and Commands
3) Use of MATLAB to Solve Engineering Problem & Algorithms, Conditional Statement, Repetition Loops, Subprograms, Matrix Manipulation.
4) Write MATLAB commands to analyse arithmetic, logical and Boolean operations.
5) Write MATLAB commands to analyse vector operations and magic matrix's.
6) Write a MATLAB program to demonstrate if and else if statement for comparing Two numbers.
7) Analyze the following operations in MATLAB a) Colon operator b) Line Plotting c) 2D plotting
8) Write MATLAB code to observe Regression and Polynomial functions.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 1 | | 1 | | | | 3 | | | | 1 | 2 | 3 |
| CO2 | 2 | 3 | 1 | | 1 | | | | 3 | | | | 1 | 2 | 3 |
| CO3 | 2 | 3 | 1 | | 1 | | | | 3 | | | | 1 | 2 | 3 |
| CO4 | 2 | 3 | 1 | | 1 | | | | 3 | | | | 1 | 2 | 3 |
| CO5 | 2 | 3 | 1 | | 1 | | | | 3 | | | | 1 | 2 | 3 |

# III/IV B.Tech.
# SEMESTER I

# B.Tech. MECHANICAL ENGINEERING

# SEMESTER-V

## ME 311 (R20): DESIGN OF MACHINE ELEMENTS

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

### COURSE OBJECTIVES:

- To introduce the fundamental knowledge of design, this deals about the shape, size and material of a particular machine element
- To implement the failure theory in designing and predicting the behaviour of machine components.
- To study the strength of Machine Elements based on stiffness and torsion when subjected to fluctuating loads
- To introduce the basic principles for design of some machine elements such as welded joints, bolted joints, cotter joints.

### COURSE OUTCOMES:

After Successful completion of course the Students will be able to

CO1. Understand the design procedure and selection of material and for static strength.

CO2. Evaluate a component subjected to static loads based on endurance strength or fatigue strength.

CO3. Analyse the stresses induced in a shaft subjected to loading conditions.

CO4. Creating an approach to design the couplings, cotter joint and Knuckle joint.

CO5. Identify the importance of various springs in mechanical and automobile industry and analysis of springs when subjected to various types of loads.

**UNIT I**

**Basics:** Basic procedure of machine design, requirements and design of machine elements, traditional design methods. Design synthesis, use of standards in design, manufacturing considerations in machine design, preferred numbers and significance. (6)

**Materials & their Properties:** Mechanical properties of materials, Common engineering materials and their properties. (4)

**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. (5)

**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, endurance – approximate estimation, reversed stresses – design for finite and infinite life, cumulative damage in fatigue, Soderberg and Goodman lines, modified Goodman diagrams, Gerber equation, fatigue design under combined stresses, impact stresses. (9)

**UNIT III**

**Fasteners:** Riveted joints, Boiler Joints & Lozenge Joint, Design of joints under eccentric loading, Welded joints, Eccentrically loaded welded joints. (15)

**UNIT IV**

**Threaded Joints** – basic types, bolt of uniform strength, materials and manufacture, eccentrically loaded bolted joints in shear, eccentric load perpendicular to axis of bolt, eccentric load on circular base. (11)

**UNIT V**

**Power Screws:** Types - Mechanics of power screws, efficiency, Design of Screw Jack and turnbuckle. (6)

**Cotter Joints:** Sleeve and Socket & Spigot cotter joints, Gib & cotter joint.. (4)

## TEXT BOOKS:

1) Design of machine elements by Bhandari, Tata McGraw Hill book Co.
2) Machine Design by P.C. Sharma & D.K. Agarwal.
3) Design of Machine Elements by Sharma &Purohit ,PHI

## HAND BOOKS TO BE ALLOWED IN UNIVERSITY EXAMINATION:

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

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | 1 | | | | | | | | | 3 | 2 | 2 |
| CO2 | 3 | 3 | 2 | 1 | | | | | | | | | 2 | 3 | 3 |
| CO3 | 3 | 3 | 3 | 1 | | | | | | | | | 2 | 3 | 2 |
| CO4 | 3 | 3 | 3 | 2 | | | | | | | | | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | 3 | | | | | | | | | 2 | 3 | 1 |

# ME312 (R20): DYNAMICS OF MACHINES

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To understand the force-motion relationship in components subjected to external forces and analysis of standard mechanisms and the analysis of governors is introduced to solve related engineering problems.
- To Analys the components subjected to forces and standard analysis of governors and Gyroscope affect is introduced to solve related engineering problems.
- To evaluate the undesirable effects of unbalances resulting from prescribed motions in mechanism and to learn about principles in mechanisms used for stability control.
- To evaluate the performance of a machine based on its dynamic characteristics, including its response to 1 DoF Vibrations and solve related engineering problems.
- To analyze the dynamic behavior of machines and their components, and identify the sources of 2 DoF Vibration effect.

## COURSE OUTCOMES:

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

1) Estimate of Inertia forces in a crank-slider mechanism.
2) Understand the standard Force analysis of Governors and Gyroscope Affect.
3) Applying the State of balance of typical multi-cylinder engines, Unbalance in reciprocatingmachinery.
4) Analysing the concepts Sources, effects, types of 1 DoF vibration and determination of natural frequency and reduction of vibration by dampers.
5) Communicate effectively about the design and performance of machines, including the use of technical reports of 2 DoF vibration and determination of Forced frequency and reduction of vibration by dampers.

### 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. Turning Moment diagrams, Fluctuation of energy and Flywheels (10).

### UNIT II

**Governors:** Introduction, Types of Governors, Watt Governor, Porter Governor, Hartnell Governor, Sensitiveness of a Governor, Hunting, Isochronism, Stability, Controlling force, Power of a Governor (8)

**Gyroscopes** : Angular Velocity, Angular Acceleration, Gyroscopic Torque, Gyroscopic Effect on Naval Ships, Stability of a two wheel vehicle.(6)

**UNIT III**

**Balancing :**Introduction, Static balancing, Dynamic balancing, Transferring of a Force from one plane to another, Balancing of Several Masses in Different planes, Primary & Secondary Balancing of Reciprocating Mass , Balancing a locomotive, effect of Partial Balancing, Balancing of In line Engines and V Engines.(12)

**UNIT IV**

**Fundamentals of Vibration**:- Introduction, Definitions, Vector method of representing Harmonic Motions, Addition of two simple Harmonic motion of the same frequency. (6)

**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. (6)

**Damped Free Vibrations of Single Degree of Freedom Systems**:- Introduction, Different types of damping, Free vibrations with viscous damping, Logarithmic Decrement, Viscous dampers, Coulomb damping, Structural damping, Interfacial damping. (6)

**UNIT V**

**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, Critical speed of a light shaft having a single disc without damping, critical speed of a light shaft having a single disc with damping, Vibration, isolation and transmissibility, vibration measuring instruments.(14)

**Two Degrees of Freedom Systems:** Introduction, Principal modes of vibration, undamped dynamic vibration absorber.(4)

## TEXT BOOKS:

1) Theory of Machines by S.S. Rattan
2) Mechanical Vibrations – G.K.Groover
3) Mechanical Vibrations – RaoV.Dukkipati, J.Srinivas, PHI

## REFERENCE BOOKS:

1) Theory of Machines by T. Bevan
2) Theory of Mechanisms and Machines by A. Ghosh and A.K. Mallik.
3) Mechanical Vibration – S.S.Rao.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |
| CO2 | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |
| CO4 | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |

# ME313 (R20): METAL CUTTING AND MACHINE TOOLS

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OUTCOMES:

**CO1: Understanding:** Students will be able to explain the fundamental concepts of machine tool operations, including the function of cutting tools, the role of feed and speed in machining, and the various types of cutting forces generated during machining.

**CO2: Applying:** Students will be able to apply their knowledge of metal cutting to select appropriate cutting tools for a given machining operation, adjust cutting parameters to achieve desired surface finish and dimensional accuracy, and troubleshoot common machining problems.

**CO3: Analysing:** Students will be able to analyze the performance of cutting tools and machining processes, using techniques such as tool life analysis, power consumption analysis, and surface roughness measurement.

**CO4: Evaluating:** Students will be able to evaluate the effectiveness of different cutting tool geometries and machining strategies in terms of their impact on cutting performance, tool life, and surface finish. CO5: Creating: Students will be able to design and develop machining processes to meet specific manufacturing requirements, using their knowledge of cutting tool selection, machining parameters, and surface finish and dimensional accuracy.

**UNIT I**

**Machining Processes and Machine Tools:** Introduction, Primary and Auxiliary Motions in machine tools, parameters defining working motions of a machine tool. (3)

**Lathe:** Constructional details, specifications, classification of lathes**. (3)**

**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. (9)

**UNIT II**

**Drilling Machines:** Types and specifications, spindle feed mechanism, drilling operations, drilling time. (4)

**Shaping and Planning:** Constructional details, types of shapers and planers, specifications, Quick Return Mechanism and automatic feed mechanisms. (4)

**UNIT III**

**Grinding Machines:** General Principles, Wheel materials, Selection and specification of grinding wheels, Truing and Dressing of grinding wheels, types of grinding machines. (7)

**Surface Finishing Operations:** Honing and Lapping operations. (3)

**UNIT IV**

**Milling Machines:** Working Principle, Size and Specification, Up and Down Milling, Types of milling machines, Description and working of Universal Milling machine, Milling operations, Milling cutters, Indexing methods and Indexing Head, related problems. (12)

**Cutting Tool Materials**: Requirements of Tool materials and types, economics of machining. (3)

**UNIT V**

**Theory of Metal Cutting:** Introduction, Basic elements of machining, Nomenclature ofsingle 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. (3)

Heat Generation and temperature distribution in metal cutting, cutting fluids- types and required characteristics. (3)

## TEXT BOOKS:

1) Workshop Technology Vol. II by Hazra Chowdary
2) Production Engineering by P.C. Sharma, S.Chand & Co.

## REFERENCE BOOKS:

1) Materials and Processes in Manufacturing by E.Paul De Garmo, J.T. Black and Ronald A.Kohser.
2) Machining and machining process by PN.Rao, TMH.
3) Manufacturing Science by Ghosh & Mallick.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | | | | | | | 2 | | | 3 | 2 | 2 |
| **CO2** | 3 | 2 | | 2 | | | | | | 2 | | | 3 | 2 | 2 |
| **CO3** | 2 | 3 | 2 | | | | | | | 2 | | | 3 | 2 | 1 |
| **CO4** | 3 | 3 | 3 | 2 | | | | | | 2 | | | 3 | | 2 |
| **CO5** | 3 | 1 | 3 | 2 | 1 | | | | | 2 | | | 3 | 1 | 1 |

# ME314/A (R20): I.C. ENGINES & GAS TURBINES

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To familiarize with the basic components and working principles of different IC engines and also the various testing methods to estimate the performance of IC engines.
- To know the fuel supply systems and combustion processes understand combustion and various parameters and variables affecting it in various types of IC engines.
- To make the student about the working of Reciprocating and Rotary Compressors.
- To make the student about various types of Gas turbines their working principles and basic principles of Jet and Rocket propulsion systems.

## COURSE OUTCOMES:

1) Understanding the fundamental principles of IC engines, including their thermodynamic cycles, combustion processes, and energy conversion mechanisms.
2) Ability to analyze and evaluate the performance of IC engines using relevant performance parameters such as efficiency, power output, and specific fuel consumption.
3) Knowledge of different types of IC engines, including spark-ignition engines, compression-ignition engines, and their respective advantages and disadvantages.
4) Understanding of the operating principles of various engine components, including cylinders, pistons, valves, and fuel injection systems.
5) Ability to design and optimize IC engines for specific applications, including power generation, automotive and transportation, marine, and aerospace.

**UNIT I**

I.C. Engines: Introduction, Basic engine nomenclature, Review and classification of I.C.Engines, working principles of S.I. and C.I. Engines (both 4 stroke and 2-stroke) - valve timing and Port Timing diagrams - Differences between S.I. & C. I. and 2 stroke & 4 stroke engines.

**UNIT II**

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.

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.

**UNIT III**

Testing 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.

**UNIT IV**

Reciprocating Air Compressors: Classification, Operation, Effect of clearance volume, compression ratio, volumetric efficiency, power input, Single-stage and Multi-stage compressors, Effect of inter-cooling, optimum intermediate pressure in a two-stage compressor.

Rotary Compressors: Introduction, Types and their applications, principles of working, static and total head values, Centrifugal compressor- velocity vector diagrams, pressure coefficient, pre whirl, Axial flow compressor - polytropic efficiency, Surging, Choking and Stalling, Centrifugal compressor versus axial flow compressor.

**UNIT V**

Gas Turbines: Closed and Open cycle gas turbines, analysis of closed cycle gas turbine, efficiencies of Compressor and turbine, cycles with inter-cooling, reheat and regeneration.

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.

## TEXT BOOKS:

1) Treatise on heat Engineering -Vasandani& Kumar-Metropolitan Book Company, Delhi
2) Thermal Engineering- Rajput - Laxmi Pub, New Delhi
3) Fundamentals of I.C.Engines – H.N. Gupta, PHI, New Delhi.

## REFERENCE BOOKS:

1) Fundamentals of I.C. Engines - P.W. Gill, J.H. Smith & Ziurys- IBH & Oxford publ,
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.
4) I.C. Engines -V.Ganesan - T.M.H., New Delhi.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 2 | 3 | 3 | 3 |
| **CO2** | 3 | 3 | 2 | 2 | 3 | 2 | | | | | | 2 | 3 | 3 | 3 |
| **CO3** | 3 | 3 | 2 | 3 | 3 | 1 | | | | | | 3 | 2 | 2 | 3 |
| **CO4** | 3 | 2 | 3 | 2 | 3 | 1 | | | | | | 2 | 3 | 3 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 1 | | | | | | 2 | 3 | 3 | 2 |

# ME314/B (R20): ELEMENTS OF AEROSPACE ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To impart fundamental scientific principles for solving complex engineering problems in different domains of Aerospace engineering.
- To train the students to have successful career in the field of Aerospace Engineering and allied domains, contributing to the global economy.
- To inculcate ethical values and professional integrity, enabling the students to grow and contribute to the world.

## COURSE OUTCOMES:

1) To know the properties of standard atmosphere relevant to the aspects of aerospace engineering.
2) To understand the basics issues of aerodynamics forces acting on an airfoil.
3) To analyze the working principles of various aircraft engines systems.
4) To identify and know functions of the various components of aircraft wing.
5) To analyzee the basics aspects of space vehicles trajectories.

**UNIT I**

HISTORICAL EVOLUTION AND AIRCRAFT CONFIGURATIONS: History- Early Planes-Developments in aerodynamics- Multi-planes, biplanes and monoplanes-Components of an Airplane and Their functions, Types of Flight Vehicles, Classification-Standard Atmosphere, Altitude, Hydrostatic Equation, Geopotential and Geometric Altitudes FLIGHT VEHICLE STRUCTURES: Introduction, Fuselage-Monocoque, Semi-Monocoque Structures, Components of Wing-Spars, Ribs, Longerons, Stringers, Bulkheads, Aircraft Materials-Metallic and Non-Metallic Materials, Use of Aluminium Alloy, Titanium, Stainless Steel and Composite Materials.

**UNIT II**

BASIC AERODYNAMICS: Continuity equation, Incompressible and Compressible flow, Momentum equation, Energy equation, Speed of sound, Measurement of air speed, Compressible flow, Compressibility, Introduction to viscous flow, Laminar and Turbulent boundary layer, compressibility effect on Skin friction, Flow separation- Introduction-Airfoils - Airfoil Nomenclature, Classifications of NACA Airfoils, Wing Geometry, Aerodynamic Forces, Lift, Drag and Moment Coefficients, Co-Efficient of Pressure, Centre of Pressure, Aerodynamics Centre, Pressure Distribution Over Aerofoil, Types of Drag.

**UNIT III**

PROPULSION: Introduction, Propeller, Reciprocating Engine, Jet Propulsion-The Thrust Equation, Elements of Turbojet Engine-Turbofan Engine-Rocket Engine, Rocket Propellants-Liquid Propellants, Solid Propellants, Rocket Staging

**UNIT IV**

ELEMENTS OF AIRPLANE PERFORMANCE: Introduction: The Drag polar, Equations of Motion-Thrust required for Level, Unaccelerated Flight, Thrust available and Maximum Velocity-Power required for Level, Unaccelerated Flight, Power available and Maximum velocity- Altitude effects on Power required and Available, Rate of Climb, Gliding Flight, Absolute and Service Ceilings, Time of Climb, Range and Endurance-Propeller Driven Airplane , Jet Airplane

**UNIT V**

PRINCIPLES OF STABILITY AND CONTROL: Introduction, Definition of Stability and Control – Static stability, Dynamic stability, Control- Moments on the Airplane-Absolute angle of attack, Criteria for Longitudinal Static Stability Directional static stability –Lateral Static stabililty SPACE FLIGHT: Introduction, Orbit Equation, Basic Aspects of Space Vehicle Trajectories, Kepler's Laws, Earth and Planetary Entry,Space Explorations- Space Vehicles and Its Types, Reusable Space Vehicles, Space Shuttle, Satellites, Types of Satellites and Their Functions.

**TEXT BOOK**:

1) Anderson. J. D, Introduction to Flight, Eighth Edition, McGraw-Hill Education,2017.

**REFERENCE BOOKS:**

1) Houghton. E. L., Carpenter P.W., Aerodynamics for Engineering Students, Seventh Edition, Butterworth-Heinemann,2017.
2) Kermode. A. C, Mechanics of Flight, Eleventh Edition, Pearson Education,2007.
3) Kermode, A.C., "Flight without Formulae", McGraw Hill, 1987.
4) Clancy, L.J., "Aerodynamics", Pitman, 1986

**WEB RESOURCES:** 1) http://nptel.ac.in/

**CO-PO/PSO MAPPING MATRIX:**

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 1 | | | | | | | | | | 3 | 2 | 1 |
| **CO2** | 3 | 3 | 1 | | | | | | | | | | 3 | 2 | 1 |
| **CO3** | 3 | 3 | 1 | | | | | | | | | | 3 | 2 | 1 |
| **CO4** | 3 | 3 | 1 | | | | | | | | | | 3 | 2 | 1 |
| **CO5** | 3 | 3 | 1 | | | | | | | | | | 3 | 2 | 1 |

# ME314/C (R20): COMPUTIONAL FLUID DYNAMICS

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES

- To introduce students to the importance and applications of Computational Fluid Dynamics (CFD) and to understand the governing equations of fluid flow, including the Navier-Stokes and Euler's equations
- To familiarize students with discretization techniques such as Finite Difference Method (FDM), Finite Element Method (FEM), and Finite Volume Method (FVM) and to develop skills in applying discretization techniques to obtain finite difference equations
- To analyze stability and accuracy of numerical schemes used in CFD and to study and implement simple CFD techniques such as Lax-Wendroff technique and MacCormack's technique
- To introduce pressure correction technique and the use of staggered grids in CFD simulations and to understand the SIMPLE algorithm for pressure-velocity coupling in CFD simulations
- To explore the applications of CFD and become familiar with CFD software packages

## COURSE OUTCOMES:

1) Demonstrate an understanding of the importance and applications of CFD in the field of mechanical engineering.
2) Apply mathematical and numerical methods to solve partial differential equations.
3) Apply computational techniques to analyze fluid flow and solve engineering problems.
4) Analyze and interpret numerical results in the context of fluid dynamics.
5) Utilize CFD software packages to solve fluid flow problems.

## UNIT I

Importance and applications of CFD, Models of flow, governing equations of fluid flow – Navier Stokes and Euler's equations: Continuity, Momentum and Energy equations in differential form, Physical boundary conditions.

## UNIT II

Classification of partial differential equations, Discretization techniques- FDM, FEM, FVM, Finite Difference equations- Taylor series, order of accuracy, forward, backward and central differences for first order and second order differential equations.

## UNIT III

Difference equations, Explicit and Implicit approaches, Thomas Algorithm (TDMA). Analysis of stability, VN stability criteria for parabolic (1-D unsteady heat equation) and Hyperbolic (1st order wave equation) equations, Courant number.

**UNIT IV**

Simple CFD techniques: Lax-Wendroff technique, MacCormack's technique and Iterative and Relaxation techniques.

**UNIT V**

Pressure correction technique, staggered grid, SIMPLE algorithm, Boundary conditions for pressure correction method.Applications of CFD. CFD Software packages

## TEXT BOOKS:

1) Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, JR. McGraw Hill Education (India) Edition 2012.
2) Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.

## REFERENCE BOOKS:

1) Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson pub. 1st Edition, 2009.
2) Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Pub., 1st Edition.
3) Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan-, Narosa Pub. 2nd Edition, 2003

## WEB RESOURCES:

1) http://ocw.mit.edu/courses/mecharlical-engineering/2-29-numerigal-fluidmechanicsfall2011/
2) http:/inptel.ac.in/courses/112105045/ (IIT Kharagpur)
3) http://nptel.ac.in/courses/112107080/ (IIT Roorkee)
4) http://nptel.ac.in/courses/112104030/ (IIT Kanpur)

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO2** | 2 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO3** | 2 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO4** | 2 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO5** | 2 | 3 | 1 | | 1 | | | | | | | | 1 | 2 | 3 |

# ME315/A (R20): OPERATIONS RESEARCH

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

To provide the students with sufficient knowledge in operations research, this can be used in their respective fields.

## COURSE OUTCOMES:

| By the end of the semester, the student will be able to: | |
|---|---|
| **CO1** | Have the clear conception of Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method and Simplex method. |
| **CO2** | Grasp about the LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method, MODI method and degeneracy. |
| **CO3** | Acquire clear comprehension of LP formulation of Assignment problem. One-to-one assignment problem, optimal solution, unbalanced assignment matrix. Flight scheduling problems, Traveling salesman problem. |
| **CO4** | Possess a clear discernment about the Queuing systems and their characteristics. Analysis of Mark ovian chains, Transition diagram, queuing models .Arrow (Network) Diagram representation. Pert and CPM, Critical path calculations, Determination of critical path, determination of floats, Probability considerations in project. |
| **CO5** | Own capacity and evaluation of Monte-Carlo simulation. Random numbers and random number generation by various methods. Application problems in queuing and inventory. Game, Strategy, pay off matrix, Max min and Min max criteria of optimality ,Two person zero sum games, Dominance Property, Arithmetic method, algebraic method for 2x2 games, solution of 2xn or mx2 games. |

**UNIT I**

**Linear Programming**: Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method, Simplex method, artificial basis technique, duality, dual Simplex method. Degeneracy, alternative optima, unbounded solution, infeasible solution. (18)

**UNIT II**

**Transportation Problem:** Introduction to the problem, LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy, unbalanced transportation matrix and Maximization in transportation model. (15 )

**Unit III**

**Assignment Problem:** Introduction to the problem, LP formulation of a Assignment problem. One-to-one assignment problem, optimal solution, unbalanced assignment matrix. Flight scheduling problems, Traveling salesman problem. (15)

**UNIT IV**

**Queing Theory:** Queuing systems and their characteristics. Analysis of Markovian chains, Transition diagram, M/M/1 : FCFS/ μ / μ and M/M/1 : FCFS/ μ / N queuing models.

**Project Planning Through Networks:** Arrow (Network) Diagram representation. Rules for constructing an arrow diagram, Pert and CPM, Critical path calculations, earliest start and latest completion times, Determination of critical path, determination of floats, Probability considerations in project (18)

**UNIT V**

**Simulation:** Definition and applications. Monte-Carlo simulation. Random numbers and random number generation: Mixed congruential method, additive congruential method and multiplicative congruential method. Application problems in queuing and inventory.

**Game Theory**: Definition of Game, Strategy, pure strategy, mixed strategy, pay off matrix, Maxmin and Minmax criteria of optimality. Two person zero sum games: Pure and Mixed strategies, Dominance Property, Arthimatic method, algebraic method for 2x2 games, solution of 2xn or mx2 games (18)

## TEXT BOOKS:

1) Operations Research – H.A. Taha
2) Introduction to Operations Research – Hiller and Liberman

## REFERENCE BOOKS:

1) Introduction to Operations Research – Phillips, Ravindran, James Solegerg.
2) Optimization Theory and Applications – S.S. Rao
3) Operations Research – S.D. Sharma
4) Operations Research – Gupta and Hira
5) Pert and CPM Principles and Applications – L.S. Srinath

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | | 3 | 2 | | | | | | 3 | 2 | 1 | 2 | 3 |
| **CO2** | 3 | 2 | | 3 | 2 | | | | | | 3 | 2 | 1 | 3 | |
| **CO3** | 3 | 2 | | 3 | 2 | | | | | | 3 | 2 | 1 | 3 | 3 |
| **CO4** | 3 | 2 | | 3 | 2 | | | | | | 3 | 2 | 1 | 3 | |
| **CO5** | 3 | 1 | | 3 | 2 | | | | | | 3 | 2 | 1 | 2 | 3 |

# ME315/B (R20): PROCESS PLANNING AND COST ESTIMATION

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

1) Gain knowledge in fundamental concepts of process planning.
2) Understand process planning activities.
3) To know the components in cost estimation.
4) Develop the skills to estimate the machining time and production costs.

## COURSE OUTCOMES:

After completion of the course, the students will be able to

1) Ability to understand and apply the process planning.
2) Ability to optimize manufacturing processes.
3) Ability to estimate costs.
4) Estimate the machining time and production costs.
5) Knowledge of manufacturing technologies.

**UNIT I**

Introduction of Process Planning- methods of process planning, drawing interpretation, material evaluation, steps in process selection, production equipment and tooling selection

**UNIT II**

Process planning activities- process parameter calculation for various production processes, selection of jigs and fixtures, selection of quality assurance methods, documents for process planning, economics of process planning, case studies

**UNIT III**

Introduction to cost estimation- importance of costing and estimation, methods of costing, elements of cost estimation, types of estimates, estimating procedure, estimation of labor cost, material cost, allocation of overhead charges, calculation of depreciation cost, break even analysis and related problems

**UNIT IV**

Machining time estimation- importance of machine time calculation, machining time for different lathe operations, drilling and boring time calculations, Machining time calculation for Milling, Shaping, Planning and Grinding

**UNIT V**

Production costs- different production processes for different jobs, estimation of forging cost, estimation of welding cost, estimation of foundry cost, estimation of machining cost.

## TEXT BOOKS:

1) Peter Scalon, Process Planning, Design/ Manufacture Interface, Elsevier Sci. & Tech. 002.
2) Ostwaal P.F. and Munez J., Manufacturing Processes and Systems, 9th ed., John Wiley 1998.
3) Chitale A.V. and Gupta R.C., Product Design and Manufacturing, 2nd ed., Prentice Hall 2002

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 1 | 1 | 1 | | | 2 | 2 | 2 | 1 | 2 | 1 | 2 |
| **CO2** | 2 | 2 | 2 | 2 | 1 | 1 | | | 2 | 2 | 2 | 2 | 2 | 1 | 2 |
| **CO3** | 2 | 1 | 1 | 2 | 1 | 1 | | | 2 | 2 | 2 | 2 | 1 | 1 | 2 |
| **CO4** | 2 | 2 | 2 | 3 | 1 | 1 | | | 1 | 1 | 2 | 1 | 1 | 1 | 2 |
| **CO5** | 2 | 2 | 3 | 2 | 1 | 1 | | | 1 | 1 | 2 | 2 | 1 | 1 | 2 |

# ME315/C (R20): TOTAL QUALITY MANAGEMENT

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To know the concept of Quality management.
- To have the exposure on Quality methodologies.
- To gain knowledge on Quality principles.
- To familiarize students with the various tools and techniques used in Total Quality Management.

## COURSE OUTCOMES:

1) To introduce the tools and techniques used in TQM, such as Six Sigma methodologies.
2) To provide an understanding of the principles and concepts of TQM and their applications in various industries and organizations.
3) To analysing skills in problem-solving, decision-making, and continuous improvement.
4) To provide practical training through case studies.
5) To examine the impact of Total Quality Management on various aspects ofan organization.

**UNIT I**

Introduction - Need for quality - Evolution of quality - Definition of quality - Dimensions of manufacturing and service quality. Basic concepts of TQM - Definition of TQM – TQM Framework -Contributions of Deming, Juran and Crosby – Barriers to TQM.

**UNIT II**

TQM PRINCIPLES- Leadership – Strategic quality planning, Quality statements - Customer focus–Customer orientation, Customer satisfaction, Customer complaints, Customer retention –Employee involvement– Motivation, Empowerment, Team and Teamwork, Recognition and Reward, Performance appraisal.

**UNIT III**

Continuous process improvement – PDSA cycle, 5s, Kaizen - Supplier partnership – Partnering, Supplier selection, Supplier Rating. The seven traditional tools of quality – New management tools – Six-sigma: Concepts, methodology, applications to manufacturing, service sector including IT.

**UNIT IV**

Bench marking– Reason to bench mark, Benchmarking process – FMEA – Stages, Types. Quality circles – Quality Function Deployment (QFD) – the voice of the customer, house of quality, QFD process.

**UNIT V**

TPM Concepts, improvement needs – Cost of Quality – Taguchi quality loss function - Performance measures. Need for ISO 9000- ISO 9000-2000 Quality System – Elements, Documentation, Quality auditing- QS9000 – ISO 14000 – Concepts, Requirements and Benefits Case studies of TQM, Implementation in manufacturing and service sectors including IT.

## TEXT BOOK:

1) Dale H.Besterfiled, at., "Total Quality Management", Pearson Education Asia, Third Edition, Indian Reprint (2006).

## REFERENCE BOOKs:

1) James R. Evans and William M. Lindsay, "The Management and Control of Quality", 6th Edition, South-Western (Thomson Learning), 2005.
2) Oakland, J.S. "TQM – Text with Cases", Butterworth – Heinemann Ltd., Oxford, 3 rd Edition, 2003.
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.
5) Girish Pathak,"Total Quality Management- Macmillan publishers India Ltd.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 3 | 2 | - | - | 2 | - | 3 | 3 | 3 | 3 | 3 |
| **CO2** | 3 | 2 | 2 | 2 | 2 | 2 | - | - | - | - | 2 | 2 | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 2 | - | 3 | 2 | 3 | 2 | 2 |
| **CO4** | 2 | 2 | 3 | 3 | 2 | 1 | - | - | - | - | 2 | 2 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 3 | - | - | 2 | - | 2 | 2 | 2 | 3 | 1 |

# ME316 (R20): FUNDAMENTALS OF RESEARCH METHODOLOGY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

1) To get the idea of the Research Process.
2) Knowledge from the Literature survey.
3) Providing systematic analysis & enhance the research quality.
4) Develop the Report Writing Skills & ethics.
5) Knowledge about the IPR & Patents.

## COURSE OUTCOMES:

After completion of this course, students will be able to –

| | |
|---|---|
| **CO1** | Understand the different types of research and research process |
| **CO2** | Analyse the phases involved in conducting research |
| **CO3** | Apply this knowledge to formulate research questions |
| **CO4** | Develop research plans in their respective fields. |
| **CO5** | Understand about the patents and journal publications. |

**Unit-I**

Introduction to Research Methodology: Objectives of Research, Motivation in Research, Types of Research, Research process and Phases of Research.

**Unit-II**

Research Design: Need, Problem Definition, variables, research design concepts, Literaturesurvey and review, Research design process, Errors in research.

**Unit-III**

Research Modeling: Types of Models, Model building and stages, Data consideration and Testing, Heuristic and Simulation modeling. Simulation: Need for simulation, Types of simulation.

**Unit-IV**

Report Writing: Pre-writing considerations, Thesis writing, formats of report writing, Formats ofpublications in Research Journals. Technique of Interpretation, Precaution in Interpretation,Significance of Report writing, Different steps in writing Report, Layout of the Research Report,Types of Reports, Report Format, Typing Instructions, Oral Presentations.

**Unit-V**

Research Ethics and Morals: Issues related to plagiarism, collaborative models and ethics, acknowledgements. *Intellectual Property Rights:* copy rights, copy left; Patents, Industrial designs, Trademarks.

## TEXT BOOKS:

1) C.R. Kothari: Research Methodology, Methods & Techniques, 2nd Edition, New Age International Publications.
2) Krishnaswamy, K N SivaKumar, AppaIyer and Mathiranjan M (2006), Management Research Methodology; Integration of Principles, Methods and Techniques (Person Education, New Delhi).
3) R Pannerselvam, Research Methodology. PHI.

## REFERENCE BOOKS:

1) Graziano, A.M., Raulin, M.L : Research Methods – A Process of Inquiry, Pearson Publications.
2) Bhandarkar& Wilkinson: Methodology and Techniques of Social Research, Himalaya publications, 2009.
3) Bell. J.2005: Doing your Research Project, 4th Edition, Open University Press, Berkshire.
4) How to write a Thesis:, Murray.R. Tata McGraw-Hill.
5) Writing for Academic Journals, Murray. R. 2009, McGraw-Hill International.
6) A Handbook of Academic Writing, Murray, R. and Moore, S. 2006, Tata McGraw-Hill.
7) Wrinting for Publication, Henson, K.T. 2005.
8) Ranjit Kumar, Research Methodology; a step-by-step Guide for Beginners, SAGE Publications.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 | PS O4 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 3 | 1 | 3 | 2 | 1 | 1 | 2 | 1 | 1 | - | 1 | 1 | | - | 3 |
| **CO2** | - | 3 | 2 | 1 | 1 | 1 | - | 2 | 1 | 1 | - | 1 | 1 | | - | 3 |
| **CO3** | 2 | 3 | 2 | 2 | 2 | 1 | 1 | 2 | 1 | 1 | - | 1 | 1 | | - | 3 |
| **CO4** | 1 | - | - | - | - | - | - | 3 | 1 | - | - | 1 | 1 | | - | 3 |
| **CO5** | - | - | 1 | 1 | 1 | 1 | 1 | 2 | - | 1 | - | 1 | 1 | | - | 3 |

# ME351 (R20): MACHINE SHOP PRACTICE LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

1) The lab aims to teach students the basic concepts of machining, including the different types of tools and machines, the different operations that can be performed, and the proper use of measuring tools and equipment.
2) Provides students with hands-on experience in operating different types of machines and tools, such as lathes, milling machines, grinders, and drill presses.
3) The lab presents students with various real-world machining problems, such as how to make a part to a specific dimension or how to produce a complex shape. Students are encouraged to use their knowledge of machining 4.
4) Provides an opportunity for students to work together on machining projects, allowing them to practice collaboration and teamwork skills that are essential in many manufacturing and engineering settings.
5) Safety is a top priority in a machine shop practice lab. Students are taught how to use machines and tools safely and are required to follow proper safety procedures to minimize the risk of injury to themselves or others.

## COURSE OUTCOMES:

1) Ability to safely and effectively use basic machine tools such as lathes, milling machines, and drill presses.
2) To understand different materials and their properties, and ability to select appropriate cutting tools and speeds for different materials.
3) To analyze Drilling and tapping operations which can produce surface finishes that are smooth and free of burrs, if the proper tools and techniques are used. High-quality surface finishes are important for producing parts that meet aesthetic and functional requirements.
4) Application of Milling and shaping operations allow for a wide range of part designs and shapes to be created, providing flexibility in the design and production process.
5) To understand Planning and slotting operations can be used on a range of materials, including metals, plastics, and composites, making them a versatile option for machining operations.

**TURNING:**

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 Planning and Slotting Machines

**GRINDING:**

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

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 3 | 3 | 3 | 2 |
| CO2 | 3 | 2 | 3 | 3 | 2 | 2 | | | | | | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 3 | 2 | | | | | | 2 | 3 | 2 | 3 |
| CO4 | 3 | 2 | 2 | 3 | 3 | 2 | | | | | | 2 | 3 | 3 | 2 |
| CO5 | 2 | 3 | 2 | 2 | 2 | 2 | | | | | | 2 | 2 | 2 | 2 |

# ME352 (R20): FUELS & I.C. ENGINES LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To make the students familiar with the engine fuel and air supply system and modern automotive engines
- To make the students about the combustion phenomenon of CI and SI engine
- To make the students familiar with the valve timing and port timing diagrams
- To make the students understand about single and multi cylinder petrol engines
- To teach the students Load test Heat alance test.

## COURSE OUTCOMES:

At the end of course the students will be able to:

1) Can explain fuel systems, combustion and emission aspects of IC engines.
2) Able to apply knowledge in developing engine combustions
3) Can explain the 2-stroke and 4-stroke engines.
4) Can solve load test calculations
5) Able to Can solve viscosity

## ANY TEN EXPERIMENTS OUT OF THE FOLLOWING ARE TO BE PERFORMED:

1) Viscosity Measurement using Redwood No.I or No. II viscometer
2) Viscosity Measurement using Saybolt viscometer
3) Carbon residue test using Conradson's carbon residue apparatus.
4) Calorific value of gas using Junker's gas calorimeter.
5) Measurement of flash point using Pensky Martin's and Abel's apparatus.
6) Measurement of flash and fire points using Cleveland's apparatus.
7) Valve timing and port timing diagrams.
8) Air compressor - To determine Volumetric and Isothermal efficiencies.
9) Blower test Rig. - To determine Overall efficiency.
10) Single cylinder Diesel engine - Load test and Heat Balance Test.
11) Multi cylinder Petrol engine - Load Test, Heat Balance and Morse test
12) Multi cylinder Petrol engine - Economic speed test and variable speed test.
13) Single cylinder Diesel engine - variable compression ratio test.
14) Multi cylinder Diesel engine - Load test and Heat Balance test.
15) Two stroke petrol engine - Load test and Heat Balance test.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 2 | 2 | 2 | | | | | | | | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 1 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 2 | 3 |
| **CO5** | 2 | 3 | 2 | 3 | 2 | | | | | | | | 2 | 3 | 2 |

# ME353 (R20): SOFT SKILLS LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OUTCOMES:

| | STATEMENT | BTL |
|---|---|---|
| **CO1** | Introspect & develop a planned approach towards his career & life in general. | L4 |
| **CO2** | Students will apply the fundamental inputs of communication skills in making speech delivery, individual conference, and group communication | L5 |
| **CO3** | Able to write a functional and chronological resume, reports, circulars etc. | L6 |
| **CO4** | Develop thinking ability and polish his expression in group discussions. | L4 |
| **CO5** | Be prepared for the personal interview through mock interviews while being aware of the various kinds of interviews. | L5 |

**Unit I Self-Development**

Introduction to soft skills, Self-Management: Self-Evaluation, Self-Discipline, Self-Criticism, Self-awareness, Self-Esteem, Positive Thinking, Perceptions and Attitudes, Values and Belief Systems, Personal success factors, Handling failure, Knowing Yourself, identifying one‘s strengths and weaknesses, SWOT analysis, Career Planning & Goal setting

**Unit II Presentation & Public Speaking**

Presentation skills: Professional Presentation, Nature of Oral Presentation, Planning a Presentation, Preparing the Presentation, Delivering the Presentation.Public Speaking, Group discussion, Interview preparation, Book Review and PPT (a review on any book in form of PPT 5 slides)

**Unit III Writing Skills**

Business Writing: Letter writing, Writing Formal Letters, Technical Report Writing, Memo, Notices/Circulars Agenda and Minutes of a Meeting, E-Mail, Job Application, Preparation of CV and Resume writing.

**Unit IV Stress and Time Management**

Introduction, Stress in Today‘s Time: Identify the Stress Source, Signs of Stress, Ways to Cope with Stress : Healthier Ways to Combat Stress, Steps to be Taken in the Organizations : Open communication, Time Management, Working towards Your Goals, Smart Work, Prioritize your Tasks,4 Ds of Decision Making

**Unit V Ethics, Etiquette and Mannerism**

Professional Etiquette: Etiquette at Meetings, Etiquette at Dining. Involuntary Awkward Actions, Public Relations Office(PRO)‘s Etiquettes, Technology Etiquette : Phone Etiquette, Email Etiquette, Social Media Etiquette, Video Conferencing Etiquette, Interview Etiquette, Dressing Etiquettes : for Interview, offices and social functions, Ethical Values: Importance of Work Ethics, Problems in the Absence of Work Ethics.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |
| **CO2** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |
| **CO3** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |
| **CO4** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |
| **CO5** | - | - | - | 2 | 2 | - | - | 2 | 3 | 3 | - | 3 | - | - |

# ME354 (R20): INDUSTRIAL/ RESEARCH INTERNSHIP (2 MONTHS)

| | | |
|---|---|---|
| Sessional Marks | : | **100** |

## COURSE OBJECTIVES:

- Expose technical students to the industrial environment to enhance their understanding and prepare them for professional roles in the industry.
- Provide opportunities for students to develop and refine real-time technical and managerial skills required for their future jobs.
- Familiarize students with current technological developments and advancements relevant to their subject area of training.
- Enable students to apply the knowledge and experience gained from industrial internships in classroom discussions and problem-solving activities.
- Encourage a quest for knowledge and promote the practical applicability of learned concepts in real-world job scenarios.

## COURSE OUTCOMES:

1) Demonstrate a comprehensive understanding of the industrial environment and its relevance to their field of study.
2) Apply acquired technical and managerial skills effectively in real-world job situations.
3) Stay updated with the latest technological advancements and incorporate them into their professional practice.
4) Integrate knowledge gained from industrial internships into classroom discussions and contribute to problem-solving activities.
5) Exhibit a proactive approach towards learning and continuously seek opportunities to apply acquired knowledge and skills in practical settings

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | 2 | | | 3 | | | 2 | | | | 1 | 2 | 3 |
| **CO2** | 1 | 3 | 2 | | | 3 | | | | | | | 1 | 2 | 2 |
| **CO3** | 1 | 3 | 2 | | 2 | 3 | | | | | | | 1 | 1 | 3 |
| **CO4** | 1 | 3 | 2 | | | 3 | | | 2 | | | | 1 | 2 | 1 |
| **CO5** | 1 | 3 | 2 | | | 3 | | | | 2 | | | 1 | 1 | 1 |

# III/IV B.Tech.
# SEMESTER II

# B.Tech. MECHANICAL ENGINEERING

## SEMESTER-VI

## ME321 (R20): DESIGN OF TRANSMISSION ELEMENTS

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

### COURSE OBJECTIVES:

- To provide basic design skill with regard to various transmission elements like clutches, brakes, bearings and gears.
- This course gives the insight of slider and roller bearings and the life prediction.
- Emphasize the fundamentals of transmission elements for various mechanical applications

### COURSE OUTCOMES:

1) Analyze design considerations for different types of clutches and brakes.
2) Design different types of bearings for static and dynamic load.
3) Creating design recommendations for forgings, casting, welded products, rolled sections, turned parts etc.
4) Evaluate the suitable bearing based on the application of the loads and predict the life of the bearing.
5) Synthesis of gears to obtain maximum power transmission

**UNIT I**

**Shafts:** Design of solid and hollow shafts for strength – For Bending, Torsion, Combined bending and torsion and combined bending, torsion and axial loads. (7)

**Keys:** Introduction, Design of square and flat keys (3)

**UNIT II**

**Shaft Couplings:** Regid couplings – Muff Coupling, Flange coupling, Flexible coupling – Modified Flange coupling (5)

**UNIT III**

**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) (8)

**Ball and Roller Bearings:** Static load, Dynamic load, Equivalent radial load, selection of ball and roller bearings (7)

**UNIT IV**

**Belt Drives :** Flat and V-belts, Belt constructions, Geometrical relationships, Analysis of belt tensions, condition for maximum power, Selection of V-belts – Selection of Pulleys.(11) **CHAIN DRIVES:** Introduction, Chain drives, Advantages of chain drives over belt drives, Polygonal effect, Selection of roller chains. (4)

**UNIT V**

**Spur Gears :** Classification of gears, Terminology of spur gear, standard systems of Gear Tooth, Force analysis, Gear tooth failures, Selection of material, Beam Strength of gear teeth, lubrication, Lewis Equation. (6)

**Helical Gears:** Terminology of helical gears, virtual number of teeth, Tooth proportions, force analysis, Beam Strength of helical gears, effective load on gear tooth, wear strength of helical gears. Lewis Equation. (3)

**Bevel Gears:** Terminology, force analysis, Beam Strength of bevel gears, wear strength. Lewis Equation. (3)

**Worm Gears:** Terminology, Force analysis, Strength rating of worm gears, Wear rating of worm gears. (3)

## TEXT BOOKS:

1) Design of machine elements by Bhandari, Tata McGraw Hill book Co.
2) Machine Design by P.C. Sharma & D.K. Agarwal.

## HAND BOOKS TO BE ALLOWED IN UNIVERSITY EXAMINATION:

1) Design data book, P.S.G. College of Tech, Coimbatore
2) Design data book, Mahadevan & Balaveera Reddy - CBS Pub.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | | | | | | | | | 1 | 3 | 2 | 2 |
| **CO2** | 3 | 3 | 2 | | | | | | | | | 3 | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | | | | | | | | | 3 | 2 | 3 | 2 |
| **CO4** | 3 | 3 | 3 | | | | | | | | | 3 | 2 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | | | | | | | | | 3 | 2 | 3 | 1 |

# ME322 (R20): HEAT TRANSFER

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To impart a comprehensive knowledge of various modes of heat transfer.
- To empower the students for solving heat transfer problems in the industry.
- To equip the student in the design of heat exchangers

## COURSE OUTCOMES:

After successful completion of course the student should be able to

**CO1:** Familiarize the basic concept of heat transfer.

**CO2:** Understand the analytical solving in the process of heat transfer (conduction, convection and radiation).

**CO3:** Know the necessity and importance of Dimensionless parameters of convective heat transfer.

**CO4:** Design various types of heat exchanger & Extended surfaces.

**CO5:** Apply the scientific and engineering principles to analyze and design aspects of engineering systems that relate to modes of heat transfer.

**UNIT I**

**Introduction:** Basic Modes and Laws of Heat transfer, thermal conductivity, Steady state Heat Conduction, General conduction equation in Cartesian, Cylindrical and Spherical coordinates, initial and boundary conditions. (5)

**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.(8)

**UNIT II**

**Extended Surfaces:** Types, Applications, Fin materials, Heat transfer from fins with uniform cross section, Fin efficiency and Effectiveness.(5)

**Transient Heat Conduction:** (One dimensional only) - Lumped heat capacity systems. (4)

**UNIT III**

**Forced Convection:** Introduction, Principles of convection, Mass, Momentum and Energy equations for boundary layer, Hydrodynamic and thermal boundary layers and their thicknesses, concept of turbulence. Correlations for heat transfer in Laminar and Turbulent flows over a flat plate, and in pipes, relation between fluid friction and heat transfer in laminar & turbulent flows-Reynolds-Colburn Analogy. (14)

**UNIT IV**

**Natural Convection:** Approximate analysis for laminar film on a vertical plate, Correlations for vertical plates, horizontal plates, vertical and horizontal cylinders, inclined surfaces. (9)

**RS**: Classification, types of heat exchangers, Flow arrangement, Temperature distribution, Overall heat transfer coefficient, Fouling factor, LMTD and NTU methods of Heat exchanger analysis, correction for LMTD for use with multi pass and cross flow Heat Exchangers, Effectiveness. (9)

**UNIT V**

**Radiation:** Fundamentals of Radiation: Basic Concepts and definitions, Absorptivity, Reflectivity, Transmisivity, concept of Black body, Laws of Radiation, Kirchhoff's law, Planck's law, Wein's law, Stefan Boltzman's law. (9)

**Radiant Heat Transfer:** Heat Exchange by radiation between two finite parallel surfaces,Electrical analogy, solid angle and Radiation intensity, radiant heat transfer between two finite black and gray surfaces, shape factor, Radiation shields. (9)

## TEXT BOOKS:

1) Heat and Mass Transfer – Sachdeva, New Age India, New Delhi
2) Heat Transfer—Rajput, Laxmipubl, New Delhi.

## REFERENCE BOOKS:

1) Heat transfer - J.P.Holman, MGH, New York.
2) Heat transfer - S.P.Sukhatme, TMH.
3) Heat Transfer – Cengel and Boles, TMH, New Delhi

**NOTE: Heat and Mass Transfer Data Book by Kothandaraman and Subramanian to be allowed in University Examination**

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | - | - | - | - | - | - | - | 2 | - | - |
| CO2 | 2 | 3 | 1 | 1 | - | - | - | - | - | 1 | - | - |
| CO3 | 3 | 2 | - | 1 | - | - | - | - | - | 1 | - | - |
| CO4 | 3 | 3 | 2 | 1 | - | - | - | - | - | 1 | - | - |
| CO5 | 2 | 3 | 3 | - | - | - | - | - | - | 1 | - | - |

# ME323 (R20): ADVANCED MANUFACTURING ENGINEERING

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

To motivate and challenge students to understand and develop an appreciation of the processes

- To impart knowledge and understanding about Jigs and Fixtures.
- To impart knowledge for various Gear and Thread manufacturing processes.
- To impart knowledge for various Surface treatment methods.
- To understand the Press working tools – Dies types for various sheet metals.
- To implement and manage quality control measures in advanced manufacturing systems with Machine vision.

## COURSE OUTCOMES:

After successful completion of the course, the students are able to

1) Understand the fundamentals of Jigs and Fixtures.
2) Design and Develop the Gear and Thread manufacturing processes.
3) Understand the kinds of Surface Treatment processes.
4) Design and optimization of Press working tools and varieties of dies for sheet metals.
5) Communicate effectively about the design and performance of advanced manufacturing processes and systems with Computer aided inspection and Machine vision systems.

**UNIT – I**

**Jigs &Fixtures:** Introduction, design considerations in 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, milling. (8)

**UNIT – II**

**Gear Manufacturing:** Introduction to various gear manufacturing methods, gear shaping, gear hobbing, bevel gear generation-principles and methods, gear finishing methods. (5)

**Thread Manufacturing Processes:** Thread rolling, thread milling, thread grinding. (2)

**UNIT – III**

SURFACE TREATMENT: Scope, Cleaners, Methods of cleaning, Surface coating types, ceramic and organic methods of coating, and economics of coating.Electro forming, Chemical vapor deposition, Physical vapor deposition, thermal spraying, Ion implantation, diffusion coating, Diamond coating and cladding

**UNIT – IV**

**Press Working Tools:** Major components of a press, shear action in die cutting operation, Blanking and Punching operations, clearance and shear as applied to punching / blanking operations, centre of pressure and its calculation, crap strip layout for blanking, simple related problems. (6)

Types of Dies-compound die, combination die, progressive die. (3)

Drawing die – Calculation of blank size, number of draws, percentage reduction, radius on punch and die, total drawing force. (3)

Bending die – Bending methods, spring back, bending allowance, bending force.(3)

**UNIT – V**

**Computer Aided Inspection:** Types of CMM (Coordinate Measuring Machines), CMM construction, CMM operation and programming, CMM software, Flexible inspection systems, CMM applications and benefits. (8)

**Machine vision**: principle and introduction to stages in machine vision, image acquisition and digitization, image processing and analysis, interpretation, machine vision applications.(7)

## TEXT BOOKS:

1) A Text book of Production Engineering by P.C.Sharma, S.Chand& Co.
2) Manufacturing Science by Ghosh&Mallik,

## REFERENCE BOOKS:

1) Manufacturing engineering & technology by Kalpak Jain, Pearson Education / PHI
2) Engineering metrology by R.K.Jain, Dhanpathrai& Sons
3) Automation, production systems & CIM by M.P.Groover, Pearson Education / PHI.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 1 | 2 | 2 | | | | 1 | | 1 | 3 | 2 | 1 |
| **CO2** | 2 | 2 | 2 | 2 | 2 | 2 | | | | 1 | | 2 | 2 | 2 | 2 |
| **CO3** | 2 | 3 | 2 | 2 | 2 | 2 | | | | 1 | | 2 | 2 | 1 | 2 |
| **CO4** | 2 | 3 | 3 | 1 | 2 | 2 | | | | 1 | | 3 | 3 | 2 | 3 |
| **CO5** | 2 | 3 | 2 | 1 | 2 | 2 | | | | 1 | | 2 | 2 | 3 | 2 |

# ME324/A (R20): INDUSTRIAL ENGINEERING AND MANAGEMENT

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- It aims to provide the students with an understanding of basics of productivity and Material requirement planning.
- To introduce students to the various functional areas of management, including finance, accounting, marketing, and operations, and to demonstrate how they are integrated in industrial engineering and management.
- Understanding supply chain management: Students will learn how to manage the flow of goods and services from the supplier to the end customer while minimizing costs and maximizing efficiency.
- To expose to forecasting and its methods, plant location and facility layout.
- To understand the basics in the field of Management and business organizations.

## COURSE OUTCOMES:

After completion of the course, the students will be able to

1) Developing an understanding of organizational behavior, including leadership, Motivation, and communication, and how to apply these principles in a business Setting.
2) Students will be able to design and manage industrial facilities, including layout, plant selection, and production systems.
3) Students will be able to analyze supply chain systems, including inventory control, procurement, and logistics, and identify opportunities for improvement.
4) Students will be able to understand and apply principles of organizational behavior, including leadership, motivation, and communication, to improve organizational effectiveness.
5) Students will be able solve problems related to quantitative and qualitative methods in forecasting.

**UNIT -I**

Forecasting: Forecasting variables, forecasting procedure, methods of forecasting: moving average, least squares, simple exponential smoothing, linear regression, correlation coefficient, problems. (6)

Production systems: Continuous and intermittent production. Mass and flow production, batch production, job order production. (3)

Plant Location and Facilities layout: Necessary factors governing plant location, principles of plant layout, types of layouts (3)

**UNIT – II**

Materials Management and MRP: Functions of materials management, purpose of inventories, types of inventories, relevant costs in inventory control, ABC and VED analysis, Single period inventory model.(6)

Materials requirement planning (MRP): Importance of MRP and CRP, MRP system inputs and outputs, bill of materials, MRP logic (3)

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

**UNIT – III**

General Management: Principles of scientific management, Principles of general management, Levels of Management, Managerial skills, brief treatment of managerial functions: planning, organizing, staffing, directing, coordinating and controlling. (6)

Forms of Business Organization: Salient features of sole proprietorship, partnership, Joint Stock Company: private limited and public limited companies. (6)

**UNIT – IV**

Marketing Management: Concept of selling and marketing – differences, functions of marketing, market research, Purchasing methods, selection of vendor ,advertising and sales promotion methods, distribution channels-types, product life cycle. (6)

Financial Management: Functions of finance, simple and compound interest, depreciation, common methods of depreciation: straight line method , declining balance method, sum of years digits method ,Types of depriciation (6)

**UNIT-V**

Supply Chain Management: Introduction, need for supply chain management, Elements of supply chain management, Logistics, E-commerce, Steps in creating an effective supply chain, supplier management. (6)

Personnel Management: The personnel Management function, job analysis and job design, job description, job specification, recruitment, selection, performance appraisal. (6)

## TEXT BOOKS:

1) Introduction to work study – ILO
2) Engineering Economy – Theusen & Theusen
3) Fundamentals of Marketing – Williams J Stanton
4) Operations Management – Joseph G.Monks, Tata McGraw Hill
5) Production and Operations Management by Stevenson

## REFERENCE BOOK:

1) Materials Management – Gopalakrishnan and Sudhakaresan

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 1 | 1 | - | 1 | - | - | 1 | 1 | 1 | 2 | 3 | 2 | 2 |
| **CO2** | 3 | 3 | 3 | 2 | - | - | - | - | - | - | 3 | 3 | 2 | 3 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 3 | 3 | 2 | 3 | 2 |
| **CO4** | 3 | 2 | 1 | 1 | - | 1 | - | - | 1 | 3 | 2 | 2 | 2 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | - | - | - | - | 3 | 3 | 2 | 3 | 2 |

# ME324/B (R20): PRODUCTION PLANNING AND CONTROL

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To understand the different types of production systems and the internal organization of production planning and control.
- To estimate forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques.
- To understands the importance and function of inventory and to be able to apply for its control and Management.
- To apply routing procedures and differentiate schedule and loading and interpret scheduling policies and aggregate planning.
- To understand dispatching procedure and applications of computers in production planning and Control.

## COURSE OUTCOMES:

After completion of the course, the students will be able to

1) Ability to understanding of production planning and control.
2) Ability to develop production plans.
3) Ability to manage inventory.
4) Ability to use production management software.
5) Ability to create value stream mapping, waste reduction, and continuous improvement

**UNIT I**

**INTRODUCTION**: Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Organization of production planning and control department Production systems: Continuous and intermittent production. Mass and flow production, batch production, job order production, production functions (12)

**UNIT II**

Project Planning through networks: Arrow (Network) diagram representation, rules for constructing an arrow diagram, PERT, CPM, Critical path calculations, Determination of critical path, Determination of floats, Probability considerations in project.(12)

**UNIT III**

Introduction to Crashing Materials Management, inventory control and MRP: Functions of materials management, inventory control, Inventory control techniques - ABC, VED and FSN analysis. Materials requirement planning (MRP): Importance of MRP, MRP system inputs and outputs, bill of materials, MRP logic. (12)

**UNIT IV**

Aggregate planning: Long range, intermediate range and short range plans, the aggregate planning problem, aggregate planning methods, mathematical planning models, theoretical planning models (LDR) and heuristic and computer search models, problems. Master Production Schedule; Master Schedule formation – inputs and outputs Routing: Routing procedure – Route sheets– Factors affecting routing. (12)

**UNIT V**

Scheduling –definition–Difference with loading, Scheduling and loading guidelines, Standard scheduling methods – forward scheduling and backward scheduling, Johnson‘s rules. Dispatching – activities of dispatcher – dispatching procedure – follow up –definition –for existence of functions – types of follow up, applications of computer in production planning and control. (12)

## TEXT BOOKS:

1) Elements of Production, Planning and Control by Samuel Eilon
2) Operations management by Joseph G.Monks, Tata McGraw-Hill Inc,

## REFERENCE BOOKS:

1) Production and Operations management by R.Pannerselvam, PHI, 2nd edition, 2006.
2) Production and Operations Management by S.N.Chary, TMH (4th edition).
3) Production Planning and Control, Mukhopadyay, PH.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 2 | 1 | 1 | 1 | | | 2 | | 1 | 1 | 2 | 1 | 2 |
| **CO2** | 2 | 2 | 2 | 2 | 1 | 1 | | | 2 | | 1 | 2 | 2 | 1 | 2 |
| **CO3** | 2 | 1 | 1 | 2 | 1 | 1 | | | 1 | | 1 | 2 | 1 | 1 | 2 |
| **CO4** | 2 | 2 | 2 | 2 | 1 | 1 | | | 1 | | 1 | 1 | 1 | 1 | 1 |
| **CO5** | 2 | 2 | 2 | 2 | 1 | 1 | | | 1 | | 1 | 2 | 1 | 1 | 1 |

# ME324/C (R20): PRODUCT LIFECYCLE MANAGEMENT

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To know the fundamental concepts of PLM.
- To study the importance of Product Data Management and Tools of communication.
- To create communication tools for collaborative work.
- To gain the knowledge on optimization of design products.
- To create an awareness on digital manufacturing.

## COURSE OUTCOMES:

After completion of the course, the students will be able to

1) Students will be able to comprehend the fundamental concepts of PLM.
2) Apply PLM systems in organization verticals including production, sales and marketing.
3) Acquire Knowledge of PLM software tools.
4) Relate optimization theories for the design of products.
5) Apply PLM concepts for service industry and E-Business.

**UNIT I**

INTRODUCTION TO PRODUCT LIFE CYCLE MANAGEMENT (PLM) Definition, PLM Lifecycle model, Threads of PLM, Need for PLM, Opportunities and benefits of PLM, Views, Components and Phases of PLM, PLM feasibility study, PLM visioning –PLM Concepts, Processes and Workflow: Characteristics of PLM, Environment driving PLM,PLM Elements, Drivers of PLM, Conceptualization, Design, Development, Validation, Production, Support of PLM (12)

**UNIT II**

PRODUCT DATA MANAGEMENT (PDM) PROCESS AND WORKFLOW PDM systems and importance, reason for implementing a PDM system, financial justification of PDM implementation. Versioning, check-in and checkout, views, Metadata, Lifecycle, and workflow.Applied problems and solution on PDM processes and work flow Collaborative Product Development: Engineering vaulting, product reuse, smart parts, engineering change management, Bill of materials and process consistency, Digital mock-up and prototype development, design for environment, virtual testing and validation, marketing collateral. (12)

**UNIT III**

TOOLS OF COMMUNICATION FOR COLLABORATIVE WORK Creation of 3DXML and CAD drawing using CAD software.Creation of an animation for assembly instructions on 3D via composer, creation of an acrobat 3D document. Applied problems and solutions on tools of communication for collaborative work.(12)

**UNIT IV**

KNOWLEDGE AND OPTIMIZATION OF DESIGN PRODUCTS Know how, best practices, parameterization of design, Applied problems and Solution on optimization of products using power copy, publication, parameters, formula, rule, check, design table, configuration, reaction. (1)

**UNIT V**

DIGITAL MANUFACTURING – PLM Digital manufacturing, benefits manufacturing, manufacturing the first-one, Ramp up, virtual learning curve, manufacturing the rest, production planning. Developing a PLM strategy and conducting a PLM assessment: Strategy, Impact of strategy, implementing a PLM strategy, PLM initiatives to support corporate objectives. Infrastructure assessment, assessment of current systems and applications. (12)

## TEXT BOOKS:

1) Grieves, Michael. “Product Lifecycle Management”, McGraw-Hill, 2006.
2) Burden, Rodger “PDM: Product Data Management”:, Resource Pub, 2003

## REFERENCE BOOKS:

1) Fabio Guidice, Guido La Rosa, “Product Design for the environment- A life cycle approach”, Taylor and Francis 2006
2) Robert J. Thomas, “New product development: managing and forecasting for strategic success”, J.Wiley, 1993.
3) Gerd Hartmann, Ulrich Schmidt, “Product life cycle management” with SAP, Galileo Press, Incorporated, 2005.
4) Stark, John, “Product Life Cycle Management: Paradigm” for 21st Century Product Realization, Springer-Verlag, 2004.
5) Saaksvuori, Antti and Immpnen, Anselmi. “Product Lifecycle Management”, Springer-Verlag, 2004.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 1 | 1 | 1 | | | 2 | 2 | 2 | 1 | 2 | 2 | 1 |
| **CO2** | 2 | 2 | 2 | 2 | 1 | 1 | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 |
| **CO3** | 2 | 3 | 1 | 2 | 1 | 1 | | | 2 | 3 | 2 | 2 | 2 | 1 | 2 |
| **CO4** | 2 | 3 | 2 | 3 | 1 | 1 | | | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| **CO5** | 2 | 3 | 3 | 2 | 1 | 1 | | | 2 | 2 | 2 | 2 | 2 | 2 | 2 |

# ME325/A (R20): MECHANICAL MEASUREMENTS &METROLOGY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- Inspection of engineering parts with various precision instruments.
- Design of part, tolerances and fits
- Principles of measuring instruments and gauges and their uses.
- To Evaluation and inspection of surface roughness.
- To Inspection of spur gear and thread elements.

## COURSE OUTCOMES:

After successful completion of the course, the students are able to:

1) Students will be able to design tolerances and fits for selected product quality
2) They can choose appropriate method and instruments for inspection of various gear elements and thread elements
3) They can understand the standards of length, angles, they can understand the evaluation of surface finish and measure the parts with various comparators.
4) The quality of the machine tool with alignment test can also be evaluated by them.
5) Students will be able to standards of length, end and line standards

**UNIT – I**

**Metrology:** Introduction, Elements of engineering measurements, Linear and angular measurements, standards of length, end and line standards.(7)

**Linear and Angular Measurements: Precision** measurement, bore gauges, straight edges, slip gauges, angle gauges, sine bars, spirit levels, auto collimator. (8)

**UNIT – II**

**Strain Measurement:** Introduction, electrical resistance strain gauges principle, Method of fixing and bridge circuits for measuring strain changes, Gauge factor, Temperature compensation strain gauge. Rosette, Strain gauge applications.(8)

**Pressure Measurement:** Introduction, pressure measurement terms, Pressure units, Bourdontube pressure gauge, Diaphragm and Bellows, Bridgeman gauge, Low pressure measurement: McLeod gauge, thermal conductivity gauge. (7)

**UNIT – III**

**Comparators:** Mechanical comparators, Reed comparator, Sigma comparator, electrical and electronic comparators, solex pneumatic gauge, projectors, tool makers microscope (7)

**Metrology of Screw Threads And Gears:** Measurement of various elements of threads, major, minor and effective diameter, thread micrometer, measurement of pitch, gear inspection, measurement of tooth thickness, gear tooth caliper. (8)

**UNIT – IV**

**Limits, Fits and Gauges:** Limits, fits, tolerance and allowance, theory of limits and fits and their selection, hole bass and shaft basis system, Indian standard system of limits and fits, simple problems. Inter changeability, selective assembly, limit gauges, Taylor's principle of limitgaugeing, plug gauges, ring gauges. (15)

**UNIT – V**

**Measurement Of Surface Finish**: Surface texture, roughness, waviness, Indian standard terminology, Methods of measuring surface finish, Taylor Hobson Talysurf. (8)

**Interferometry:** NPL flatness interferometry and gauge length interferometer. (3)

**Static & Dynamic Alignment Tests:** Alignment tests on Lathe, Drilling Machine and Milling Machine. (4)

## TEXT BOOKS:

1) Metrology - R.K.Jain, Khanna publishers
2) Hand Book of Industrial Metrology by ASTME
3) Mechanical Measurements by R.S.Sirohi & H.C.Radhakrishna

## REFERENCE BOOKS:

1) Engg.Metrology – D.M.Antony
2) A text book of Engg.Metrology – I.C.Gupta.
3) Mechanical Measurements – T.B.Beckwith&N.L.Buck

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 2 | 1 |
| CO2 | 3 | 2 | 2 | 2 | 3 | | | | | | | | 2 | 2 | 2 |
| CO3 | 2 | 3 | 3 | 2 | 2 | | | | | | | | 1 | 2 | 2 |
| CO4 | 3 | 3 | 2 | 3 | 2 | | | | | | | | 2 | 1 | 3 |
| CO5 | 2 | 2 | 3 | 2 | 2 | | | | | | | | 2 | 3 | 2 |

# ME325/B (R20): COMPOSITE MATERIALS

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To introduce the fundamentals of composite materials and their importance in various industries and to understand the classification of composites and the different types of matrices and reinforcements used.
- To study the production techniques for fibers and their characteristics in composite materials.
- To familiarize students with the processing techniques for polymer matrix composites (PMC), metal matrix composites (MMC), and ceramic matrix composites (CMC).
- To examine the properties, advantages, and limitations of different types of composites and to explore the applications of composites in aerospace and automotive industries.
- To understand the processing techniques and applications of metal matrix composites (MMC) and ceramic matrix composites (CMC) and to introduce special composites such as carbon/carbon composites and their processing techniques.

## COURSE OUTCOMES:

1) Understand the fundamentals of composite materials and their importance in engineering applications. Classify composites based on their matrix and reinforcement materials.
2) Explain the production techniques for fibers used in composites and their properties. Apply various processing techniques for polymer matrix composites, metal matrix composites, and ceramic matrix composites.
3) Analyze the characteristics, advantages, and limitations of different types of composites. Identify and discuss the applications of composites in aerospace and automotive industries.
4) Understand the processing techniques and applications of metal matrix composites. Understand the processing techniques and applications of ceramic matrix composites.
5) Describe the properties, advantages, and limitations of carbon/carbon composites. Apply the principles of composite materials in solving engineering problems and making design decisions.

## UNIT I

INTRODUCTION TO COMPOSITES Fundamentals of Composites – Need For Composites – Enhancement of Properties – Classification of Composites – Matrix-Polymer Matrix Composites (PMC), Metal Matrix Composites (MMC), Ceramic Matrix Composites (CMC) – Reinforcement – Particle Reinforced Composites, Fibre Reinforced Composites. Applications of Various Types of Composites. Fiber Production Techniques for Glass, Carbon And Ceramic Fibers.

**UNIT II**

Polymer Resins – Thermosetting Resins, Thermoplastic Resins – Reinforcement Fibres – Rovings – Woven Fabrics – Non Woven Random Mats – Various Types of Fibres. PMC Processes – Hand Lay Up Processes – Spray Up Processes – Compression Moulding – Reinforced Reaction Injection Moulding – Resin Transfer Moulding – Pultrusion – Filament Winding – Injection Moulding. Fibre Reinforced Plastics (FRP), Glass Fibre Reinforced Plastics (GFRP).

**UNIT III**

Laminates- Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates.-Applications of PMC In Aerospace, Automotive Industries

METAL MATRIX COMPOSITES Characteristics Of MMC, Various Types Of Metal Matrix Composites Alloy Vs. MMC, Advantages of MMC, Limitations of MMC, Reinforcements – Particles – Fibres. Effect of Reinforcement – Volume Fraction – Rule of Mixtures.

**UNIT IV**

Processing of MMC – Powder Metallurgy Process – Diffusion Bonding – Stir Casting – Squeeze Casting, A Spray Process, Liquid Infiltration In-Situ Reactions-Interface-Measurement of Interface Properties- Applications of MMC In Aerospace, Automotive Industries

**UNIT V**

CERAMIC MATRIX COMPOSITES AND SPECIAL COMPOSITES Engineering Ceramic Materials – Properties – Advantages – Limitations – Monolithic Ceramics – Need For CMC – Ceramic Matrix – Various Types Of Ceramic Matrix Composites- Oxide Ceramics – Non Oxide Ceramics – Aluminium Oxide – Silicon Nitride – Reinforcements – Particles- Fibres-Whiskers. Sintering – Hot Pressing – Cold Isostatic Pressing (CI Ping) – Hot Isostatic Pressing (HI Ping). Applications of CMC In Aerospace, Automotive Industries Carbon /Carbon Composites – Advantages Of Carbon Matrix – Limitations Of Carbon Matrix Carbon Fibre – Chemical Vapour Deposition Of Carbon On Carbon Fibre Perform. Sol-Gel Technique- Processing of Ceramic Matrix Composites

## TEXT BOOKS:

1) Mathews F. L. And Rawlings R. D., “Composite Materials: Engineering and Science”, 1st Edition, Chapman and Hall, London, England, 1994.
2) Chawla K. K., “Composite Materials”, Second Edition, Springer – Verlag, 1998.

## REFERENCE BOOKS:

1) Clyne, T. W. And Withers, P. J., “Introduction to Metal Matrix Composites”, Cambridge University Press, 1993.
2) Strong, A.B., “Fundamentals of Composite Manufacturing”, SME, 1989.

3) Sharma, S.C., “Composite Materials”, Narosa Publications, 2000.
4) Broutman, L.J. and Krock, R.M., “Modern Composite Materials”, Addison-Wesley, 1967. 5. ASM Hand Book, “ Composites”, Vol.21, ASM International, 2001

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO2** | 2 | | 1 | | | | | | | | | | 1 | | 3 |
| **CO3** | 2 | 2 | 1 | | | | | | | | | | 1 | | 3 |
| **CO4** | 2 | | 1 | | | | | | | | | | 1 | 1 | 3 |
| **CO5** | 1 | 2 | 1 | | | | | | | 1 | | | 1 | | 3 |

# ME325/C (R20): FARM MACHINERY AND EQUIPMENT

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- Understand the objectives and importance of farm mechanization and Classify farm machines and learn about their materials of construction and heat treatment.
- Analyze the principles of operation and select appropriate machines for crop production and evaluate field capacities and economic considerations in farm mechanization.
- Familiarize with primary and secondary tillage equipment and their forces of operation and learn about earth-moving equipment and their construction and working principles.
- Calibrate and adjust sowing, planting, and transplanting equipment and Understand fertilizer application equipment and weed control and plant protection equipment.
- Study cutting mechanisms and their types, construction, and adjustments, Explore crop harvesting machinery and handling equipment.

## COURSE OUTCOMES:

1) Understand the importance and benefits of farm mechanization, classify different types of farm machines based on their functions and materials used and Analyze and select suitable machines for specific crop production requirements.
2) Assess field capacities and economic factors related to farm mechanization and apply knowledge of forces acting on tillage tools and their impact on operations.
3) Calibrate and adjust sowing, planting, and transplanting equipment for optimal performance and evaluate and select appropriate equipment for fertilizer application, weed control, and plant protection.
4) Apply knowledge of cutting mechanisms and make necessary adjustments and understand the functioning and operation of crop harvesting machinery and forage equipment.
5) Demonstrate knowledge of threshing mechanics and operate different types of threshers and operate and adjust harvesting and equipment

**UNIT I**

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.

**UNIT II**

Tillage; primary and secondary tillage equipment. Forces acting on tillage tools. Field operation patterns. Draft measurement of tillage equipment: Earth moving equipment: their construction &working principles viz Bulldozer, Trencher, Excavators etc.; sowing, planting & transplanting equipment - their calibration and adjustments.

**UNIT III**

Fertilizer application equipment. Weed control and Plant protection equipment: sprayers and dusters, their calibration, selection, constructional features of different components and adjustments. Work physiology of men and women.

**UNIT IV**

Principles & types of cutting mechanisms. Construction & adjustments of shear & impact-type cutting mechanisms. Crop harvesting machinery: mowers, windrowers, reapers, reaper binders and forage harvesters. Forage chopping & handling equipment.

**UNIT V**

Threshing mechanics & various types of threshers. Threshers, straw combines & grain combines, maize harvesting & shelling equipment, Root crop harvesting equipment: potato, groundnut etc., Cotton picking & Sugarcane harvesting equipment.

## TEXT BOOKS:

1) Bosoi, E.S. (1990). Theory, Construction and Calculation of Agricultural Machines (Vol. 1 and 2 Oxonion Press Pvt. Ltd., New Delhi.
2) Donnel Hunt. Farm Machinery and management. Iowa State University Press, Ames, USA
3) Ghosh, P.K, and Swain, S. (1993). Practical Agricultural Engineering. Naya Prokash, Calcutta.
4) Kelnin, N.I., Popov, I.F., and Sakun, V.A. (1985). Agricultural Machines. Amerind Publishers, New Delhi 5.Srivastava, A.C. (1990). Elements of Farm Machinery. Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.

## REFERENCE BOOKS:

1) Kepner, R.A., Bainer Roy, and Barges, E.C. (1978). Principals of Farm Machinery, CBS Publishers and Distributors, Delhi-17.
2) Kurtz,G.L., Thompson and Claer, P. (1984). Design of Agricultural Machinery. John Wiley & Sons, New York

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 1 | 1 | | 2 | 3 | | | | | | | 1 | 2 | 3 |
| CO2 | 2 | 2 | 1 | | 2 | 2 | | | | | | | 1 | 2 | 3 |
| CO3 | 2 | 2 | 1 | | 1 | 2 | | | | | | | 1 | 2 | 3 |
| CO4 | 2 | | 1 | | 2 | 2 | | | | | | | 1 | 1 | 3 |
| CO5 | 1 | 2 | 1 | | 2 | 2 | | | | | | | 1 | 2 | 3 |

# ME326 (R20): DESIGN THINKING FOR INNOVATION

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To introduce students to the principles and elements of design
- To familiarize students with the process of design thinking and its application in driving inventions and social innovations
- To develop skills in using tools of design thinking such as empathy, analysis, ideation, and prototyping
- To understand the role of creativity and innovation in organizations
- To explore the concept of product design and its importance in problem-solving
- To apply design thinking principles in business processes and strategic innovation
- To understand the challenges faced by businesses and how design thinking can address them
- To develop skills in defining and testing business models and prototypes

## COURSE OUTCOMES:

1) Apply design principles and design thinking processes in problem-solving and innovation.
2) Apply design thinking principles in business processes and strategic innovation.
3) Analyze and evaluate the impact and value of creativity and innovation in organizations and demonstrate creativity and innovation in developing solutions and strategies
4) Develop and present prototypes and product designs.
5) Understand the challenges and requirements of startups and develop strategies to address them and apply effective communication and presentation skills to explain design thinking processes and ideas.

**UNIT I**

Introduction to Design Thinking:

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design.Introduction to design thinking, history of Design Thinking, New materials in Industry.

**UNIT II**

**Design Thinking Process:**

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking -person, costumer, journey map, brain storming, product development

**Activity:** Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

**UNIT III**

Innovation:

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations.Creativity to Innovation.Teams for innovation, Measuring the impact and value of creativity.

Activity:Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

**UNIT IV**

Product Design:

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications. Innovation towards product design Case studies.

Activity:Importance of modelling, how to set specifications, Explaining their own product design.

**UNIT V**

Design Thinking in Business Processes:

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business –Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs. Design thinking for Startups. Defining and testing Business Models and Business Cases. Developing & testing prototypes.

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

## TEXT BOOKS:

1) Change by design, Tim Brown, Harper Bollins (2009)
2) Design Thinking for Strategic Innovation, IdrisMootee, 2013, John Wiley & Sons

## REFERENCE BOOKS:

1) Design Thinking in the Classroom by David Lee, Ulysses press
2) Design the Future, by Shrrutin N Shetty, Norton Press
3) Universal principles of design-William lidwell, kritinaholden, Jill butter.
4) The era of open innovation –chesbrough.H

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | | 1 | | | | | | | | | | 1 | | 3 |
| **CO2** | 2 | | 1 | | | | | | | | | | 1 | | 3 |
| **CO3** | 2 | | 1 | | | | | | | | | | 1 | | 3 |
| **CO4** | 2 | | 1 | | | | | | | | | | 1 | | 3 |
| **CO5** | | 2 | | | | | | | | 1 | | | 1 | | 3 |

# ME361 (R20): COMPUTER APPLICATIONS IN MECHANICAL ENGINEERING LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- The objective of this course is to develop programming skills in the C language and apply them to solve problems in various simulation exercises, computer applications, and application packages related to mechanical engineering.
- Students will gain hands-on experience in implementing numerical methods, solving differential equations, performing stress and heat transfer analysis, and utilizing relevant software packages.

## COURSE OUTCOMES:

CO1-Develop proficiency in programming using the C language to solve engineering problems and Perform heat transfer analysis in one-dimensional and two-dimensional systems.

CO2: Implement simulation exercises, such as Hart Mechanism, Paucellier Mechanism, Robert Mechanism, Scott Russel Mechanism, Watt Mechanism, Pantograph Mechanism, Four Bar Mechanism, Slider Crank Mechanism, and Tchibicheff Mechanism.

CO3: Apply numerical methods for solving engineering problems, including differential equation solutions, Gauss elimination, and stress analysis.

CO4: Apply operations research (O.R.) techniques, such as linear programming, queuing theory, critical path method (CPM), and program evaluation and review technique (PERT), to solve engineering optimization problems.

CO5: Utilize application packages relevant to mechanical engineering, such as fluid flow simulation packages like Fluent, Star CD, O.R. packages like TORA, LINDO, PRIMAERA, and MATLAB.

**Note: Develop programs for the following problems using C- language**

**SIMULATION EXERCISE: [Any TWO]**

- ★ Hart Mechanism
- ★ Paucellier Mechanism
- ★ Robert Mechanism
- ★ Scott Russel Mechanism
- ★ Watt Mechanism
- ★ Pantograph Mechanism
- ★ Four Bar Mechanism
- ★ Slider Crank Mechanism
- ★ Tchibicheff Mechanism

**COMPUTER APPLICATIONS: [ANY FOUR]**

★ Numerical Methods
★ Differential Equation solution
★ Gauss elimination: General Matrix and skyline.
★ Two dimensional stress analysis
★ Cylinder subjected to internal pressure.
★ 1 D Heat Transfer (conduction)
★ 2 D Heat Transfer (conduction)
★ O.R. applications like L.P., Queing Theory, CPM, PERT etc..

**APPLICATIONS PACKAGES: [ANY ONE]**

Simple packages for Fluid flow like fluent, Star CD etc., O.R. Packages like TORA, LINDO, PRIMAERA, Etc., MAT Lab.Any application package in Mechanical Engineering.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | | 2 | | | | 3 | | | | 1 | 2 | 3 |
| **CO2** | 2 | 3 | 1 | | 2 | | | | 3 | | | | 1 | 3 | 3 |
| **CO3** | 2 | 3 | 1 | | 2 | | | | 3 | | | | 1 | 2 | 3 |
| **CO4** | 2 | 2 | 1 | | 2 | | | | 3 | | | | 1 | 2 | 3 |
| **CO5** | 2 | 2 | 1 | | 2 | | | | 3 | | | | 1 | 2 | 3 |

# ME362 (R20): DESIGNS & METROLOGY LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To impart the knowledge regarding importance of accuracy & precision while taking the measurements.
- Students are exposed to measuring the dimensions of mechanical components.
- Students are provided the basic knowledge about alignment of machine tools.
- Students are exposed to measure the cutting forces with the help of dynamometers.
- Students are exposed to know the importance of surface finish.

## COURSE OUTCOMES:

At the end of course the students will be able to:

1) Demonstrate the use of instruments for measuring linear (internal and external), angular dimensions.
2) Perform alignment tests on various machine tools.
3) Gain the knowledge about various design principles practically.
4) Acquire the working/ operation of various types of dynamometers.
5) Gain the knowledge about various design – manufacturing principles practically and importance of surface finish.

Any **Ten** Experiments should be performed:

1) Angle and taper measurement by Bevel Protractor & Sine Bar.
2) Internal and External taper measurement using Ball & Rollers
3) Measuring effective dia. Of thread using 2 wire, 3 wire method.
4) Measuring gear tooth thickness using gear tooth vernier.
5) Measuring internal dia. using bore dial gauge.
6) Alignment test on lathe machine
7) Alignment test on drilling machine
8) Alignment test on milling machine
9) Measuring external diameters using Micrometer& Plot X & R Charts
10) Measurement of surface finish using surf tester
11) Measuring different parameters of a thread / gear using tooth profile projector
12) Vibration measurements
13) Gyroscope

14) Balancing
15) Whirling of shafts
16) Governor
17) CAM Analysis
18) Wear & Friction measurement
19) Force & Torque measurement
20) Journal Bearing
21) Photo elastic Bench
22) Measurement of cutting forces using lathe tool dynamometer
23) Measurement of cutting forces using drill tool dynamometer.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | 2 | | | | 1 | | 1 | 3 | 2 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 1 | 2 | | | | 1 | | 2 | 3 | 2 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 1 | 2 | | | | 1 | | 2 | 3 | 2 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 1 | 2 | | | | 1 | | 3 | 3 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 1 | 1 | 2 | | | | 1 | | 2 | 2 | 3 | 2 |

# ME363 (R20): HEAT TRANSFER LABOBORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To understand the measurement of performance of refrigeration tutor and air conditioning tutor
- To understand the estimation of heat transfer rate in conduction mode of heat transfer
- To understand the effectiveness of heat transfer rate through heat exchanger in a different flow conditions
- To understand the estimation of heat transfer rate in convection & radiation mode of heat transfer

## COURSE OUTCOMES:

1) Able to calculate the COP and Capacity of the refrigeration and air conditioning plant
2) Able to estimate the heat transfer rate in conduction mode of heat transfer in Pin Fin and Metallic bar
3) Able to estimate overall heat transfer coefficient & effectiveness of heat exchanger in parallel flow and counter flow conditions
4) Able to estimate heat transfer rate in natural and forced convection mode and also by radiation mode
5) Able to estimate the Critical heat flux

## Tests on Any Ten of the Following are to be conducted:

1) Refrigeration Test Rig
2) Air Conditioning Test Rig
3) Heat Exchanger – Parallel Flow
4) Heat Exchanger – Counter Flow
5) Composite Slab / Metal Rod
6) Critical Heat flux Apparatus
7) Emissivity Apparatus
8) Pin fin – Natural Convection
9) Pin fin – Forced Convection
10) Insulating powder Apparatus
11) Drop wise and film wise condensation Apparatus
12) Forced Convection Apparatus
13) Stefan – Boltzmann's Apparatus
14) Lagged pipe Apparatus

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 2 | 2 | | | | | | | | 3 | 2 | 1 |
| **CO2** | 3 | 2 | 2 | 2 | 2 | | | | | | | | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 1 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 2 | 3 |
| **CO5** | 2 | 3 | 2 | 3 | 2 | | | | | | | | 2 | 3 | 2 |

# ME364 (R20): DELMIA & SIMULIA LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- The objective of this course is to provide students with the essential skills and knowledge required to effectively use DELMIA software for manufacturing item definition, process planning, equipment allocation, and assembly evaluation.
- The course aims to familiarize students with the key features and functionalities of DELMIA and enable them to create and manage manufacturing assembly structures, process plans, line balancing, equipment allocation, and perform static simulations and structural analysis.

## COURSE OUTCOMES:

CO1: Develop proficiency in using DELMIA software for manufacturing item definition, process planning, equipment allocation, and assembly evaluation, Create and manage the manufacturing bill of materials (BOM) structure using DELMIA.

CO2: Utilize the grouping functionality in DELMIA for efficient management of manufacturing assemblies, Reuse existing manufacturing assembly structures in DELMIA for improved productivity and efficiency.

CO3: Create process planning using DELMIA and configure preferences for optimal manufacturing operations, develop line balancing strategies using DELMIA for efficient and balanced assembly processes.

CO4: Manage multi-model environments in DELMIA for effective coordination and collaboration in manufacturing processes. Perform static simulations of models in DELMIA to evaluate structural integrity and performance.

CO5: Create materials in DELMIA and manage their properties and characteristics and structural models and scenarios in DELMIA for analyzing and optimizing manufacturing processes

1) Course Requisites: DELMIA Manufactured Item Definition Essentials
2) Creating the Manufacturing Bill of Materials Structure
3) Creating Groups
4) Reusing a Manufacturing Assembly Structure
5) DELMIA Process Planning Essentials
6) Setting the Preferences
7) Creating the Process Planning

8) Creating Automatic Line Balancing
9) Managing a Multi-model
10) DELMIA Equipment Allocation Essentials
11) DELMIA Assembly Evaluation Essentials
12) Static simulation of a model
13) Creating material
14) Structural model creation
15) Structural senario

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 2 | 2 | 1 | | | | | | | | 3 | 3 | 1 |
| **CO2** | 3 | 2 | 3 | 2 | 1 | | | | | | | | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 2 | 2 | 1 | | | | | | | | 3 | 1 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 1 | | | | | | | | 3 | 2 | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 1 | | | | | | | | 2 | 2 | 2 |

# IV/IV B.Tech.
# SEMESTER I

# B.Tech. MECHANICAL ENGINEERING

## SEMESTER-VII

## ME411 (R20): ADVANCED MACHINE DESIGN

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

### COURSE OBJECTIVES:

- Learn to design I.C engine parts under complex loading conditions.
- To Design different types of mechanical springs under various types of loads
- To Design brakes and clutches for static loading conditions.
- This course prepares for the capstone design course by providing understanding of all necessary steps and project management communication, documentation necessary to successfully execute the capstone design project.

### COURSE OUTCOMES:

**CO1:** Model the machine elements such as springs, Brakes and clutches.

**CO2:** Analyze the machine elements to design a new component.

**CO3:** Characterize the mechanical system to a real world application.

**CO4:** Synthesize the modal to design a new mechanical system

**CO5:** Execute a fully functional prototype, Utilize models and engineering analysis for design.

**UNIT – I**

Springs: Introduction; Materials; Types of springs, Helical springs under axial load, Fatigue loading, Torsion springs, Spiral springs, leaf springs (12)

**UNIT – II**

Brakes and Clutches:- Introduction to Brakes, Types, Analysis and design of block brakes, band brakes, block and 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, cone clutches and centrifugal clutches, friction materials; comparison of brakes and clutches.(12)

**UNIT – III**

Flywheel: Introduction, construction, Torque analysis, solid flywheel, Rimmed flywheel, stresses in rimmed flywheel, Design of flywheel. (8)

System design: Introduction, Human aspects of design, Standardization, Practical tips for problems encountered in design with examples. (4)

**UNIT – IV**

I.C.Engine Components: Introduction, Design of trunk type piston, connecting rod and crank shaft.(8)

Reliability and life expectances: Introduction, Method of achieving reliability, Series, Parallel and series and parallel reliability, Analysis (4)

**UNIT – V**

Optimum design: Optimization function of single variable and multi variables, optimization techniques, Interval halving and Golden section methods, optimum design of tension bar for minimum deflection, cost and weight, Torsion member for minimum deflection, cost and weight. (12)

## TEXT BOOKS:

1) Design of machine elements by Bhandari, Tata McGraw Hill book Co.
2) Machine Design by Sharma &Purohit.
3) Machine Design by Khurmi&Guptha

## HAND BOOKS TO BE ALLOWED IN UNIVERSITY EXAMINATION:

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

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | | | | | | | | | 1 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 2 | | | | | | | | | 3 | 2 | 3 | 3 |
| CO3 | 3 | 2 | 2 | | | | | | | | | 3 | 2 | 3 | 2 |
| CO4 | 3 | 2 | 3 | | | | | | | | | 3 | 2 | 3 | 2 |
| CO5 | 3 | 3 | 3 | | | | | | | | | 3 | 2 | 3 | 1 |

# ME412 (R20): AUTOMATION& COMPUTER AIDED MANUFACTURING

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To get the knowledge of various elements of manufacturing automation and CAPP system.
- To educate students by covering types of industrial robots and different material handling system required in manufacturing shop floor.
- To understand the importance of NC/CNC/DNCs in automation of machine tool based manufacturing.
- To develop the NC Program(s) in automation of machine tool based manufacturing.
- To evaluate the different advances in manufacturing system like: GT-CMS and FMS.

## COURSE OUTCOMES:

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

1) Estimate of Inertia forces in a crank-slider mechanism.
2) Understand the standard Force analysis of Governors and Gyroscope Affect.
3) Applying the State of balance of typical multi-cylinder engines, Unbalance in reciprocating machinery.
4) Analysing the concepts Sources, effects, types of 1 DoF vibration and determination of natural frequency and reduction of vibration by dampers.
5) Communicate effectively about the design and performance of machines, including the use of technical reports of 2 DoF vibration and determination of Forced frequency and reduction of vibration by dampers.

**UNIT – I**

Automation: Automation in production systems – automated manufacturing systems, computerized manufacturing support systems, reasons for automating, merits and demerits, automation principles and strategies, manufacturing industries and products, manufacturing operations – processing and assembly operations, other factory operations.(8)

Introduction to Computer Integrated Manufacturing. (2)

Computer Aided Process Planning: Introduction, retrieval CAPP system, generative CAPP systems, benefits of CAPP. (3)

**UNIT - II**

Industrial Robotics :Introduction, robot anatomy, joints and links, common robot and configurations, joint drive systems, robot control systems, end effectors, sensors in robotics, applications of robots – material handling, processing, assembly and inspection. (7)

**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, CNC software, direct numerical control, distributed numerical control, applications of NC, advantages and disadvantages of NC, adaptive control machining.(15)

**UNIT –IV**

NC Part Programming: NC coding systems, manual part programming, simple examples on drilling, milling and turning operations, computer assisted part programming, part programming with APT language, simple examples in drilling and milling operations.(15)

**UNIT – V**

Group Technology & Cellular Manufacturing: Introduction, part families, parts classification and coding, features of parts classification of coding system, OPITZ ,MICLASS, Product Flow Analysis, composite part concept, machine cell design ,applications.(6)

Flexible Manufacturing Systems :Introduction, types of FMS, components, FMS lay out configurations, computer control system, human resources, applications and benefits.(4)

## TEXT BOOK:

1) Automation, Production systems and Computer Integrated Manufacturing by M.P. Groover, Pearson Education / PHI.

## REFERENCE BOOKS:

1) CAD/CAM by M.P.Groover and E.W.Zimmers, Pearson Education / PHI.
2) CAD/CAM by P.N.Rao

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |
| **CO2** | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |
| **CO3** | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |
| **CO4** | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |
| **CO5** | 3 | 3 | 3 | 2 | 2 | 1 | | | | 1 | | 3 | 2 | 2 | 1 |

# ME413 (R20): FINITE ELEMENT METHODS

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- Understand the fundamental concepts of stress and strain analysis and their relation.
- Learn the basics of Finite Element Method (FEM) and its application to one-dimensional problems.
- Develop the skills to analyze and solve two-dimensional problems using FEM.
- Gain knowledge of beam element stiffness and its application in structural analysis.
- Acquire an understanding of scalar field problems, specifically steady-state heat transfer.

## COURSE OUTCOMES:

1) Apply the principles of stress and strain analysis to determine principal stresses and strains, and analyze the effects of temperature on structural behavior.
2) Formulate and solve one-dimensional problems using FEM, including the assembly of global stiffness matrix and load vector, and treatment of boundary conditions.
3) Analyze plane trusses using FEM, considering local and global coordinate systems, element stiffness matrix, and stress calculations.
4) Apply FEM to solve two-dimensional problems, considering plane stress, plane strain, and axi-symmetric loading conditions, and using appropriate element types and boundary conditions.
5) Analyze scalar field problems, particularly steady-state heat transfer, by formulating the governing equations, applying appropriate boundary conditions, and utilizing the functional approach.

**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, the Rayleigh-Ritz method, Weighted Residual Method, Galerkin's method, Saint venant's principle, Von Mises stress. (18)

**UNIT II**

**Basic Concepts of F.E.M. and One Dimensional Problems :**Fundamental concepts, Finite Element Modeling, 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. (9)

**Analysis of Plane Trusses:** Introduction, *Plane Trusses:* Local and Global Coordinate systems, Element Stiffness Matrix, Stress Calculations, Example of plane Truss with three members. (9)

**UNIT III**

**Two Dimensional Problems :**Introduction, Plane Stress and Plane Strain, Finite Element Modeling, Constant Strain Triangle (CST); Iso-parametric representation, Potential Energy Approach, Element Stiffness, Force terms, Galerkin Approach, Stress calculation, Problem modeling and boundary conditions, Examples of plane Stress and plane Strain problems with three degrees of freedom using CST Element.(12)

Definitions of Iso-parametric and sub-parametric Elements. (6)

**UNIT IV**

Stiffness of Beam Element.

**Axi-Symmetric solids subjected to Axi-Symmetric loading:**Introduction, Axi-Symmetric formulation, FEM using triangular element, problem modeling and boundary conditions. (7)

**UNIT V**

**Scalar Field Problems** : Introduction, steady-state heat transfer, one-dimensional heat conduction, governing equation, boundary conditions, the one dimensional element, functional approach for heat conduction.(11)

## TEXT BOOKS:

1) Introduction to Finite Elements in Engineering by Chandrupatla & Belegundu, PHI.
2) Finite Element Analysis by P.Seshu, PHI publications

## REFERENCE BOOKS:

1) Finite Element Analysis by C.S.Krishna Moorthy.
2) Finite Element Analysis by L.J. Segerlind.
3) David V. Hutton, "Fundamentals of Finite Element Analysis "McGraw Hill Company**.**

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 2 | 2 | | | | | | | | | 1 | 1 | 3 |
| **CO2** | 2 | 1 | 2 | 3 | | | | | | | | | 1 | 1 | 3 |
| **CO3** | 2 | 1 | 2 | 2 | | | | | | | | | 1 | 1 | 3 |
| **CO4** | 2 | 1 | 2 | 3 | | | | | | | | | 1 | 1 | 3 |
| **CO5** | 2 | 1 | 2 | 3 | | | | | | | | | 1 | 1 | 3 |

# ME414/A (R20): REFRIGERATION& AIRCONDITIONING

## [PROGRAM ELECTIVE –III]

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

To motivate and challenge students to understand and develop an appreciation of the processes

- To understand impart knowledge and understanding about refrigerants air refrigeration cycles.
- To impart knowledge for VCR and type of multi pressure systems.
- To impart knowledge for VAR, steam jet refrigeration
- To understand the Non Conventional Refrigeration Methods.
- To impart knowledge for air conditioning systems.

## COURSE OUTCOMES:

After successful completion of the course, the students are able to

1) Students should be able to understand various refrigeration cycles.
2) Coefficient of performance by conducting test on vapor compression refrigeration.
3) Understand the steam jet refrigeration working.
4) Calculate cooling load for air conditioning systems used for various applications
5) Evaluate performance of refrigeration cycles using Mollier charts and / or refrigerant property tables.

**UNIT I**

**Introduction to Refrigeration:** Necessity and applications, unit of refrigeration and C.O.P, mechanical refrigeration, types of ideal cycle of refrigeration, Refrigerants- desirable properties, commonly used refrigerants, nomenclature.(6)

**Air Refrigeration:** Bell Coleman cycle and Brayton cycle, Open and Dense air systems, Actual refrigeration system, refrigeration needs of aircrafts, adoption of air refrigeration, Justification, types of systems, problems. (9)

**UNIT II**

**Vapour Compression Refrigeration:** Working principle, essential components of plant, simple vapor compression refrigeration cycle, Multi pressure systems – multistage compression, multi evaporator system, Cascade system, use of p – h charts, problems.

**System Components**: Compressors- general classification, comparison, advantages and disadvantages, Condensers - classification, working, Evaporators - classification, working, Expansion devices - types, working. (7)

**UNIT III**

**Vapour Absorption System:** Calculation of max COP, description and working of $NH_3$-water system, Li - Br, $H_2O$ system, principle of operation of three fluid absorption system and salient features.(10)

**Steam Jet Refrigeration:** Principle of working, application, merits and demerits.(2)

**UNIT IV**

**Non-Conventional Refrigeration Methods:** Principle and operation of thermoelectric refrigerator and Vortex tube or Hirsch tube.(3)

**Introduction to Air Conditioning:** Psychrometric properties and processes, sensible and latent heat loads, S–load characterization and SHF, need for ventilation, infiltration, concepts of RSHF, ASHF, ESHF & ADP, concept of human comfort and effective temperature, comfort air conditioning. (9)

**UNIT V**

Industrial air conditioning requirements, air conditioning load calculations. (4)

**Air Conditioning Systems:** Classification of equipment, cooling, heating, humidification and dehumidification, filters, grills and registers, deodorants, fans and blowers, heat pump, heat sources, different heat pump circuits, application.(8)

## TEXT BOOKS:

1) Refrigeration and air conditioning - C.P.Arora, TMH.
2) Refrigeration and Air conditioning - Manohar Prasad, New Age India, New Delhi.
3) A course in refrigeration and air conditioning - S.C.Arora & Domkundwar, Dhanpat Rai & sons, New Delhi.

## REFERENCE BOOKS:

1) Principles of Refrigeration-Dossat.
2) Refrigeration and air conditioning-Stoecker.

**NOTE: Refrigeration and Air conditioning Data book by Manohar Prasad is allowed in the University Examination.**

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 3 | 2 | | | | | | | | 3 | 2 | 1 |
| CO2 | 3 | 2 | 2 | 2 | 2 | | | | | | | | 2 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 1 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 3 | 2 |

# ME414/B (R20): AUTOMOBILE ENGINEERING

## [PROGRAM ELECTIVE-III]

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **4 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To know the functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels.
- To provide the information about the each part in the automobile.
- Learning about the environmental impact of automobiles.
- Gaining knowledge on Suspension, frame, springs, ignition, controls, electrical systems and vehicle control systems.

## COURSE OUTCOMES:

1) Understanding of the working principles of automotive systems such as engine, transmission, suspension, steering, brakes, electrical and electronic systems, etc.
2) Knowledge of the fundamental principles of mechanical engineering and their application in automobiles.
3) To analyze the operation of steering and the suspension systems.
4) To develop the latest trends and technologies in the automobile industry ,including autonomous vehicles, electric vehicles, and connected cars.
5) Practical experience in terms of hands-on training.

**UNIT I**

**Introduction:** Classification of vehicles – applications, options of prime movers, transmission and arrangements. (4)

**Engine:** Engine Classifications - number of strokes, cylinders, types of combustion chambers for petrol and diesel engines, valves, valve arrangements and operating Mechanisms, Piston - design basis, types, piston rings, firing order; Crankshafts, Flywheel.(8)

**UNIT II**

**Assorted Equipment:** Fuel supply pumps, Mechanical and Electrical type Diaphragm pumps, Air and Fuel Filters, super chargers, Mufflers.(4)

**Cooling Systems:** Need for cooling system, Air and water cooling.(4)

**Lubricating Systems:** Various lubricating systems for I.C. Engines.(4)

**UNIT III**

**Electrical System:** Ignition system, Spark plugs, Distributor, Electronic Ignition ,Alternator, cutout, Current and voltage regulators, charging circuit, starting motors, lighting, instruments and accessories. (6)

**Chassis & Transmission Systems:** Introduction to Chassis & Transmission, Clutches – Single-plate and Multi-plate clutches, Centrifugal clutches, wet and dry type, actuating mechanisms.(6)

**UNIT IV**

**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. (12)

**UNIT V**

**Suspension Systems:** Need for suspension systems, springs, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment. (6)

**Vehicle Control:** steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic) (6)

## TEXT BOOKS:

1) Automobile Engineering - G.B.S.Narang.
2) Automobile Engineering - R.B.Gupta
3) Automobile Engineering - Vol I & II - Kirpal Singh

## REFERENCE BOOKS:

1) Automotive Mechanics - Joseph Heitner
2) Automobile Engineering - S.Srinivasan

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 1 | 1 | - | - | - | - | - | 1 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | - | 1 | 2 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | - | 2 | - | 2 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 2 | 3 | 2 | 2 | 3 | 1 |

# ME414 /C (R20): COMPUTER GRAPHICS

## [PROGRAM ELECTIVE-III]

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **4 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- The objective of this course is to provide students with a comprehensive understanding of computer graphics and its fundamental concepts.
- The course aims to familiarize students with various techniques and algorithms used in generating and manipulating graphical objects.
- By the end of the course, students should be able to apply these concepts and algorithms to solve problems related to computer graphics.

## COURSE OUTCOMES:

CO1: Understand the basic principles and concepts of computer graphics, including lines, line segments, polygons, and transformations.

CO2: Demonstrate knowledge of graphic primitives, display devices, and display-file structures.

CO3: Apply point plotting techniques, including incremental methods and algorithms for line and circle drawing and viewing transformations and implement windowing and clipping techniques, including the Cohen-Sutherland algorithm for efficient clipping of polygons.

CO4: Understand different types of line drawing displays, such as CRT, inherent-memory devices, and the refresh line-drawing display and segment creation, deletion, closing, and renaming using algorithmic approaches.

CO5: Apply polygon representation, interfacing algorithms, and filling techniques including antialiasing and pattern fill in and Implement transformations, such as scaling, rotation, and translation, using homogeneous coordinates and coordinate transformations.

### UNIT I

**Geometry and Line Generation:** Introduction, Lines, Line segments, Perpendicular Lines, Distance between a point and a Line, Vectors, Pixels and Frame Buffers.(6)

**Graphic Primitives:** Introduction, Display devices, Primitive operations, The Display-File Interpreter, Normalized Device Coordinates, Display-File structures.(6)

**UNIT II**

**Point Plotting Techniques:** Coordinate system, Incremental methods, Line Drawing Algorithms, Circle generators.(6)

**Line Drawing Displays:** The CRT, Inherent-Memory devices, The storage-Tube display ,The Refresh Line-Drawing Display.(6)

**UNIT III**

**Polygons:** Introduction to Polygons, Polygon representation, Polygon Interfacing Algorithms, Filling Polygons, Filling with a pattern, Initializing, Antialiasing.(6)

**Transformations:** Introduction, Scaling Transformations, Rotation, Homogeneous Coordinates and Translations, Coordinate Transformations, Rotation about an Arbitrary point, Inverse Transformations.(6)

**UNIT IV**

**Segments:** ***(Algorithmic Approach only)*** **:**Introduction, The Segment table, Segment creation, Closing a Segment, Deleting a Segment, Renaming a Segment. (12)

**UNIT V**

**Windowing and Clipping:** Introduction, The Viewing Transformation, Viewing transformation implementation, Clipping, The Cohen-Sutherland Algorithm, Clipping of Polygons. (12)

## TEXT BOOK:

1) Computer Graphics by Steven Harrington.

## REFERENCE BOOKS:

1) Procedural elements for Computer Graphics by Rogers.
2) Principles of Interactive Graphics by Newman and Sproull.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 1 | 3 | 1 | | | | | | | | 2 | 2 | 3 |
| CO2 | 3 | 2 | 2 | | 1 | | | | | | | | 3 | 2 | 3 |
| CO3 | 3 | 3 | 2 | 3 | 2 | | | | | | | | 2 | 1 | 2 |
| CO4 | 3 | 2 | 3 | | 2 | | | | | | | | 3 | 3 | 2 |
| CO5 | 3 | 1 | 2 | 3 | 3 | | | | | | | | 2 | 1 | 1 |

# ME415 (R20): MOOC's

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **0** |
| University Exam. | : | **0** | University Exam. Marks | : | **100** |

**A CANDIDATE SHALL COMPLETE ONE MOOC COURSES OF 8/12 WEEKS IN DURATION.**

1) Enrolment of MOOC course will be initiated from the date of commencement of class work for Semester VII [Fourth Year].
2) MOOC course completion certificate(s) must be submitted on or before the last instruction day of Semester VII [Fourth Year] to consider it for Regular evaluation.
3) Candidate has to pursue and acquire a certificate for a MOOC course only from the organizations / agencies approved by the concerned BoS in order to earn the 3 credits.
4) List of organizations offering MOOC courses / List of courses will be announced by the respective Board of Studies at the time of commencement of class work for semester VII [Fourth Year]

# ME415/A (R20): OPERATIONS RESEARCH

## (OPEN ELECTIVE OFFERED TO OTHER BRANCHES)

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

To provide the students with sufficient knowledge in operations research, this can be used in their respective fields.

## COURSE OUTCOMES:

| **By the end of the semester, the student will be able to:** | |
|---|---|
| **CO1** | Have the clear conception of Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method and Simplex method. |
| **CO2** | Grasp about the LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method, MODI method and degeneracy. |
| **CO3** | Acquire clear comprehension of LP formulation of Assignment problem. One-to-one assignment problem, optimal solution, unbalanced assignment matrix. Flight scheduling problems, Traveling salesman problem. |
| **CO4** | Possess a clear discernment about the Queuing systems and their characteristics. Analysis of Markovian chains, Transition diagram, queuing models. Arrow (Network) Diagram representation. Pert and CPM, Critical path calculations, Determination of critical path, determination of floats, Probability considerations in project. |
| **CO5** | Own capacity and evaluation of Monte-Carlo simulation. Random numbers and random number generation by various methods. Application problems in queuing and inventory. Game, Strategy, pay off matrix, Maxmin and Minmax criteria of optimality, Two person zero sum games, Dominance Property, Arithmetic method, algebraic method for 2x2 games, solution of 2xn or mx2 games. |

### UNIT I

**Linear Programming**: Definition and Scope of Operations Research, Mathematical formulation of the problem, graphical method, Simplex method, artificial basis technique, duality, dual Simplex method. Degeneracy, alternative optima, unbounded solution, infeasible solution.(12)

**UNIT II**

**Transportation Problem:** Introduction to the problem, LP formulation of a transportation problem. Basic feasible solution by north-west corner method, Vogel's approximation method, least cost method. Finding optimal solution by MODI method, degeneracy, unbalanced transportation matrix and Maximization in transportation model. (12 )

**Unit III**

**Assignment Problem:** Introduction to the problem, LP formulation of a Assignment problem. One-to-one assignment problem, optimal solution, unbalanced assignment matrix. Flight scheduling problems, Traveling salesman problem. (12)

**UNIT IV**

**Queing Theory:** Queuing systems and their characteristics. Analysis of Markovian chains, Transition diagram, M/M/1: FCFS/ μ / μ and M/M/1 : FCFS/ μ / N queuing models. (4)

**Project Planning Through Networks:** Arrow (Network) Diagram representation. Rules for constructing an arrow diagram, Pert and CPM, Critical path calculations, earliest start and latest completion times, Determination of critical path, determination of floats, Probability considerations in project (8)

**UNIT V**

**Simulation:** Definition and applications. Monte-Carlo simulation. Random numbers and random number generation: Mixed congruential method, additive congruential method and multiplicative congruential method. Application problems in queuing and inventory. (6)

**Game Theory**: Definition of Game, Strategy, pure strategy, mixed strategy, pay off matrix, Maxmin and Minmax criteria of optimality. Two person zero sum games: Pure and Mixed strategies, Dominance Property, Arthimatic method, algebraic method for 2x2 games, solution of 2xn or mx2 games (6)

## TEXT BOOKS:

1) Operations Research – H.A. Taha
2) Introduction to Operations Research – Hiller and Liberma

## REFERENCE BOOKS:

1) Introduction to Operations Research – Phillips, Ravindran, James Solegerg.
2) Optimization Theory and Applications – S.S. Rao
3) Operations Research – S.D. Sharma
4) Operations Research – Gupta and Hira
5) Pert and CPM Principles and Applications – L.S. Srinath

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | | 3 | 2 | | | | | | 3 | 2 | 1 | 2 | 3 |
| CO2 | 3 | 2 | | 3 | 2 | | | | | | 3 | 2 | 1 | 3 | |
| CO3 | 3 | 2 | | 3 | 2 | | | | | | 3 | 2 | 1 | 3 | 3 |
| CO4 | 3 | 2 | | 3 | 2 | | | | | | 3 | 2 | 1 | 3 | |
| CO5 | 3 | 1 | | 3 | 2 | | | | | | 3 | 2 | 1 | 2 | 3 |

# ME415/B (R20): ROBOTICS

## (OPEN ELECTIVE OFFERED TO OTHER BRANCHES)

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To provide an introduction to Robotics and Automation including robot classification, design and selection, analysis and applications in industry.
- To provide information on various types of end effectors, their design, interfacing and selection.
- To provide the details of operations for a variety of sensory devices that are used on robot the meaning of sensing, classification of sensor, that measure position, velocity & acceleration of robot joint.
- The goal of the course is to familiarize the students with the basic concepts of transformations performed by robot.

## COURSE OUTCOMES:

1) Students will be familiarized in basic components of robotics, classification of robots and their applications.
2) They will have knowledge on types of robot grippers, their usage and design considerations.
3) They attain knowledge on various types of sensory devices their working and applications.
4) Students will apply basic transformations related to the movement of manipulator and able to design a robot mechanism to meet kinematics requirements.

**UNIT – I**

Introduction to Robotics, major component so 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 application. (12)

**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. (12)

**UNIT – III**

**Robotic Sensory Devices:** Objective, Non-optical position sensors – potentiometers, synchros, inductocyn, optical position sensors – opto interrupters, optical encoders (absolute & incremental) [6]

**Proximity Sensors:** Contact type , non contact type – reflected light scanning laser sensors. [6]

**UNIT – IV**

**Touch & Slip Sensors:** Touch sensors – proximity rod & photo detector sensors, slip sensors – Forced oscillation slip sensor, interrupted type slip sensors, force and torque sensors. [12]

**UNIT – V**

**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, techniques. (12)

## TEXT BOOKS:

1) Robotic Engineering by Richard D.Klafter
2) Industrial Robotics by MikellP.Groover

## REFERENCE BOOKS:

1) Introduction to Robotics – John J.Ceaig
2) Robotics – K.S.Fu, Gonzalez &Hee
3) Robotics for Engineers by YoramKoren.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | | 2 | 2 | | 1 | 3 | 2 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | | 2 | 2 | | 2 | 3 | 2 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | | 2 | 2 | | 2 | 3 | 2 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 1 | 2 | 2 | | 1 | 2 | | 3 | 3 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 1 | 1 | 2 | 2 | | 1 | 2 | | 2 | 2 | 3 | 2 |

# ME415/C (R20): FLUID POWER & CONTROL SYSTEMS

## (OPEN ELECTIVE OFFERED TO OTHER BRANCHES)

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3+1 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- Understand the principles of hydraulic pumps, their types, and the regulation of pressure.
- Gain knowledge of different types of air compressors and their characteristics.
- Learn about hydraulic and pneumatic actuators, including linear and rotary actuators, their selection, specification, and characteristics.
- Familiarize with hydraulic and pneumatic accessories and control elements such as pressure-direction and flow control valves, relief valves, and safety valves.
- Develop an understanding of hydraulic circuits, including reciprocation, quick return, sequencing, synchronizing, accumulator, and industrial circuits, and their applications in various machines.

## COURSE OUTCOMES:

1) Select and specify hydraulic pumps based on application requirements and understand their characteristics.
2) Differentiate between various types of air compressors and their suitability for different applications and Select and specify hydraulic and pneumatic actuators for linear and rotary motion based on their characteristics.
3) Identify and utilize hydraulic and pneumatic accessories and control elements in system design and operation.
4) Design and analyze hydraulic circuits for specific applications, such as reciprocation, sequencing, and synchronizing circuits, and understand their functionality
5) Applications of Hydraulics and pneumatics and Circuit design.

**UNIT I**

**Hydraulic Pumps & Pressure Regulation:** Pressure regulation, pump types: Gear Pump,Vane Pump, Piston Pump, Combination Pumps. selection and specification of pumps, pump characteristics (12)

**UNIT II**

**Air Compressors:** Types: Piston, Screw rotary and Dynamic compressors .(6)

**Hydraulic & Pneumatic Actuators:** Linear and Rotary Actuators-Selection, Specification and Characteristics, (6)

**UNIT III**

Hydraulic and pneumatic accessories (4)

**Control and Regulation Elements:** Pressure-direction and flow control valves, relief valves, non return and safety valves-actuation systems.(8)

**UNIT IV**

**Hydraulic Circuits:** Reciprocation, quick return, Sequencing synchronizing circuits-accumulator circuits-industrial circuits-press circuits-hydraulic milling machine-grinding, planning, copying, forklift (12)

**UNIT V**

Applications, Advantages and Disadvantages of Hydraulics and pneumatics (4)

Earth mover circuits-design and selection of components-safety and emergency mandrels. (8)

## TEXT BOOK:

1) Andrew Parr, "Hydraulics and Pneumatics", (HB), Jaico Publishing House, 1999

## REFERENCE BOOKS:

1) Antony Espossito, "Fluid power with Applications", Prentice Hall, 1980
2) Dudleyt A.Pease and John J.Pippenger, "Basic Fluid Power", Prentice Hall, 1987
3) S.Ilango and V.Soundarajan “Introduction to Hydrualics And Pneumatics” PHI Publisher 2014
4) R.Srinivasan“Hydrualics and Pneumatic Controls” Vijay Nicole Imprints PVT. LTD 2004.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 3 | 2 | | | 3 | | | | | | | 1 | 2 | 3 |
| **CO2** | 1 | 3 | 2 | | | 3 | | | | | | | 1 | 2 | 3 |
| **CO3** | 1 | 3 | 2 | | | 3 | | | | | | | 1 | 1 | 3 |
| **CO4** | 1 | 3 | 2 | | | 3 | | | | | | | 1 | 2 | 3 |
| **CO5** | 1 | 3 | 2 | | | 3 | | | | | | | 1 | 1 | 3 |

# ME451 (R20): COMPUTER AIDED MANUFACTURING LABORATORY

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **4 Periods / Week** | Sessional Marks | : | **30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **70** |

## COURSE OBJECTIVES:

- To Gain knowledge about software associated with computer aided manufacturing.
- To know simple operations using computer numerical control codes.
- To illustrate the parameters suitable for manufacturing a component by using CNC machines.
- Create a computer aided manufacturing (CAM) model and generate the machining codes automatically using the CAM system.

## COURSE OUTCOMES:

1) To know the features and specifications of CNC machines.
2) Ability to develop the process planning sheets and tool layouts.
3) To Understand the CAM software and its programming.
4) Use the CAM software and prepare CNC part programs.
5) To analyse and execute the part program by using FANUC software.

## ANY TEN EXPERIMENTS SHOULD BE PERFORMED:

1) Manual Part Programming examples in plain turning, step turning, taper turning, contour turning, thread cutting, drilling, boring, taper boring, counter boring, parting off with and without using Canned Cycles and sub programs on CNC Lathe
2) Manual Part Programming examples in drilling, pocket milling and profile milling with and without using Canned Cycles and sub programs on CNC Milling Machine.
3) Modeling, part program generation and tool path simulation using any one of the CAM software packages like Master CAM, Edge CAM, Ideas, Pro - E, CATIA etc.,

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 2 | 2 | 2 | 1 | - | - | - | - | - | 1 | 3 | 3 | 3 | 2 |
| **CO2** | 2 | 2 | 3 | 2 | 1 | - | - | - | - | - | 1 | 1 | 2 | 2 | 3 |
| **CO3** | 3 | 3 | 3 | 3 | 2 | - | - | - | - | - | 2 | 3 | 3 | 3 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 2 | - | 3 | 3 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 3 | 3 | 2 | - | - | 2 | - | 3 | 3 | 3 | 3 | 2 |

# ME452 (R20): INDUSTRIAL/ RESEARCH INTERNSHIP (2 MONTHS)

| | | |
|---|---|---|
| Sessional Marks | : | **100** |

## COURSE OBJECTIVES:

- Expose technical students to the industrial environment to enhance their understanding and prepare them for professional roles in the industry.
- Provide opportunities for students to develop and refine real-time technical and managerial skills required for their future jobs.
- Familiarize students with current technological developments and advancements relevant to their subject area of training.
- Enable students to apply the knowledge and experience gained from industrial internships in classroom discussions and problem-solving activities.
- Encourage a quest for knowledge and promote the practical applicability of learned concepts in real-world job scenarios.

## COURSE OUTCOMES:

1) Demonstrate a comprehensive understanding of the industrial environment and its relevance to their field of study.
2) Apply acquired technical and managerial skills effectively in real-world job situations.
3) Stay updated with the latest technological advancements and incorporate them into their professional practice.
4) Integrate knowledge gained from industrial internships into classroom discussions and contribute to problem-solving activities.
5) Exhibit a proactive approach towards learning and continuously seek opportunities to apply acquired knowledge and skills in practical settings.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 1 | 2 | | | 3 | | | 2 | | | | 1 | 2 | 3 |
| **CO2** | 1 | 3 | 2 | | | 3 | | | | | | | 1 | 2 | 2 |
| **CO3** | 1 | 3 | 2 | | 2 | 3 | | | | | | | 1 | 1 | 3 |
| **CO4** | 1 | 3 | 2 | | | 3 | | | 2 | | | | 1 | 2 | 1 |
| **CO5** | 1 | 3 | 2 | | | 3 | | | | 2 | | | 1 | 1 | 1 |

# IV/IV B.Tech.
# SEMESTER II

# B.Tech. MECHANICAL ENGINEERING

## SEMESTER-VIII

## ME461 (R20): PROJECT WORK

| | | | | | |
|---|---|---|---|---|---|
| Practicals | : | **6 Periods / Week** | Sessional Marks | : | **50** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | : | **100** |

The Project Report has to be submitted at the end of the semester and marks will be awarded based on the Viva-voce examination.

### COURSE OBJECTIVES:

To expose the students to the following

- Offer students a glimpse into real world problems and challenges that needs Mechanical Engineering.
- Provide students with the opportunity to synthesize knowledge in the area of Mechanical Engineering.
- Introduce students to the vast array of literature available of the various research challenges in the field of Mechanical Engineering.
- Create awareness among the students of the characteristics of several domain areas where Mechanical Engineering can be effectively used.
- Enhance students knowledge and enables them to acquire skills like collaboration, communication and independent learning, prepares them for lifelong learning and the challengers a head.

### COURSE OUTCOMES

After successful completion of course the student should be able to

CO1. Acquire in-depth knowledge in the core and/or interdisciplinary area of project topic.

CO2. Critically analyze the chosen topic for arriving at conclusions.

CO3. Develop and design feasible solutions for the project topic.

CO4. Undertake research and solve real world problems in the project domain.

CO5. Apply appropriate techniques, resources and modern software tools necessary for implementing the project work.

CO6. Use project results for sustainable development of the society.

CO7. Understand the impact of project results in the context of environmental sustainability.

CO8. Understand professional and ethical responsibilities for sustainable development of society in the chosen field of project.

CO9. Function effectively as individual and a member in the project team.

CO10. Develop communication skills, both oral and written for preparing and presenting project report.

CO11. Demonstrate knowledge and understanding of cost and time analysis required for carrying out the project.

CO12. Engage in continuous learning to improve knowledge and competence in the chosen Subject area of project.

## CO-PO/PSO MAPPING MATRIX:

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PS O1 | PS O2 | PS O3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | **H** | **M** | | **M** | | | | | | | | | **H** | **M** | |
| **CO2** | | **H** | **M** | | **M** | | | | | | | | **M** | **H** | |
| **CO3** | | **M** | **H** | | **M** | | | | | | | | **H** | **M** | |
| **CO4** | | | | **H** | | **M** | | | | **M** | | | | **M** | **H** |
| **CO5** | | | **M** | | **H** | | | | | **M** | | | | **H** | |
| **CO6** | | | | | | **H** | **M** | | | | | | | | **H** |
| **CO7** | | | | | | **M** | **H** | | | | | | | | **H** |
| **CO8** | | | | | | | **M** | **H** | | | | | | | **M** |
| **CO9** | | | | | | | | | **H** | **M** | **M** | | | | **M** |
| **CO10** | | | | | | | | **M** | | **H** | **M** | | | | **H** |
| **CO11** | | | | | | | | | **M** | | **H** | | | | **H** |
| **CO12** | **M** | **M** | | | | | | | | | | **H** | | | **H** |

# ME462 (R20): SEMINAR

| | | | | | |
|---|---|---|---|---|---|
| Practicals | : | **0 Periods / Week** | Sessional Marks | : | **50** |
| University Exam. | : | **0 hrs.** | University Exam. Marks | : | **0** |

# ME463 (R20): MOOC'S

| | | | | | |
|---|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / Week** | Sessional Marks | : | **0** |
| University Exam. | : | **0 hrs.** | University Exam. Marks | : | **100** |

1) A candidate shall complete one MOOC courses of 8/12 weeks in duration.
2) Enrolment of MOOC course will be initiated from the date of commencement of class work for Semester VIII [Fourth Year].
3) MOOC course completion certificate(s) must be submitted on or before the last instruction day of Semester VIII [Fourth Year] to consider it for Regular evaluation.
4) Candidate has to pursue and acquire a certificate for a MOOC course only from the organizations / agencies approved by the concerned BoS in order to earn the 2 credits.
5) List of organizations offering MOOC courses / List of courses will be announced by the respective Board of Studies at the time of commencement of class work for Semester VIII [Fourth Year].

# HONOURS DEGREE COURSES

# MEH101 (R20): MODERN VEHICLE TECHNOLOGY

*II Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

**COURSE OBJECTIVES:**

Students undergoing this course are expected to

- Understanding the principles and functions of modern vehicle systems.
- Identifying the latest technological advancements in the automotive industry.
- To understand the Global positioning system for automotive and autonomous vehicles.
- To learn the safety systems for the automobiles includes Airbags, Seat Belt Tightening System, ABS.

**COURSE OUTCOMES:**

CO1-To learn the recent developments in Alternate power generation for a vehicle.

CO 2-To understand the advanced suspension, Braking, and Safety systems in automobile.

CO 3-To evaluate the vehicle efficient Noise and pollution control techniques in automobiles.

CO 4-To apply the safety concepts to various vehicle operation and control systems.

CO 5-Analysing the impact of environmental regulations on modern vehicle technology.

**UNIT–I**

**DRIVERINFORMATIONSYSTEMS**

Introduction, Driver Support Systems–Driver Information, Driver Perception, Driver Convenience, Driver Monitoring. Vehicle Support Systems – General Vehicle Control, Collision Avoidance, Vehicle Status Monitoring

**UNIT – II**

**DRIVER ASSISTANCE SYSTEMS**

Global Positioning Systems, Geographical Information Systems, Navigation Systems, Automotive Vision System, Road Recognition, Driver Assistance Systems - Connected Vehicles, Autonomous Vehicles

**UNIT – III**

**SAFETY SYSTEMS**

Active and Passive Safety Systems, Airbags, Seat Belt Tightening System, Collision Warning Systems, Child Lock, Anti-Lock Braking Systems, Traction Control, Electronic Stability Programme. Crash Worthiness of Vehicle, Vehicle Crash Testing, Testing With Dummies. Security Systems - Anti Theft Technologies, Smart Card System, Number Plate Coding.

**UNIT – IV**

**COMFORT SYSTEMS**

Active Suspension Systems, Requirement and Characteristics, Different Types, Power Steering, Collapsible and Tiltable Steering Column, Power Windows, Biometric Systems. Adaptive Control Systems: Adaptive Cruise Control, Adaptive Noise Control, Anti Spin Regulation.

**UNIT – V**

**ELECTRONIC ENGINE MANAGEMENT**

Single Point and Multipoint Injection System, Working of Electronic Fuel Injector, Different Types of Electronic Fuel Injection Systems Like L, K, KE, LU, LH and Motronic, ME & MH Systems, Cylinder Cut-Off Technology.

## TEXT BOOKS:

1) K.K. Ramalingam, "Automobile Engineering", Scitech Publications Pvt. Ltd., 2005
2) Crouse/Anglin "Automotive Mechanics"
3) T. Kenneth Garrett, Kenneth Newton and William Steeds, "The Motor Vehicle" 13th Edition, Butterworth-Heinemann Limited, London, 2005.
4) "Automotive technology " H.Hertz

## REFERENCE BOOKS:

1) Beranek. L.L. Noise Reduction, McGraw-Hill Book Co., Inc, Newyork, 1993
2) Bosch Hand Book, 3rd Edition, SAE,1993

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | 1 | - | - | - | - | 2 | 2 | 3 | 3 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 1 | 1 | - | - | - | - | 1 | 2 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 2 | 2 | 2 | 3 | 3 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | - | 2 | - | 2 | 3 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 2 | 3 | 3 | 3 | 3 | 1 |

# MEH102 (R20): AUTOMOBILE ENGINEERING

*II Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To know the functioning of the engine and its accessories, gear box, clutch, brakes, steering, axles and wheels.
- To provide the information about the each part in the automobile.
- Learning about the environmental impact of automobiles.
- Gaining knowledge on Suspension, frame, springs, ignition, controls, electrical systems and vehicle control systems.

## COURSE OUTCOMES:

- ★ Understanding of the working principles of automotive systems such as engine, transmission, suspension, steering, brakes, electrical and electronic systems, etc.
- ★ Knowledge of the fundamental principles of mechanical engineering and their application in automobiles.
- ★ To analyze the operation of steering and the suspension systems.
- ★ To develop the latest trends and technologies in the automobile industry, including autonomous vehicles, electric vehicles, and connected cars.
- ★ Practical experience in terms of hands-on training.

**UNIT I**

Introduction: Classification of vehicles – applications, options of prime movers, transmission and arrangements. (4)

Engine: Engine Classifications - number of strokes, cylinders, types of combustion chambers for petrol and diesel engines, valves, valve arrangements and operating Mechanisms, Piston - design basis, types, piston rings, firing order; Crankshafts, Flywheel. (7)

Assorted Equipment: Fuel supply pumps, Mechanical and Electrical type Diaphragm pumps, Air and Fuel Filters, super chargers, Mufflers. (4)

**UNIT II**

Cooling Systems: Need for cooling system, Air and water cooling. (3)

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)

**UNIT III**

Chassis & Transmission Systems: Introduction to Chassis & Transmission, Clutches – Single-plate and Multi-plate clutches, Centrifugal clutches, wet and dry type, actuating mechanisms. (7)

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)

**UNIT IV**

Suspension Systems: Need for suspension systems, springs, shock absorbers, axles – front and rear, different methods of floating rear axle, front axle and wheel alignment. (8)

**UNIT V**

Vehicle Control: steering mechanisms and power steering, types of brakes and brake actuation mechanisms (air and hydraulic). (7)

## TEXT BOOKS:

1) Automobile Engineering - G.B.S.Narang.
2) Automobile Engineering - R.B.Gupta
3) Automobile Engineering - Vol I & II - Kirpal Singh

## REFERENCE BOOKS:

1) Automotive Mechanics - Joseph Heitner
2) Automobile Engineering - S.Srinivasan

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | 1 | - | - | - | - | 2 | 1 | 3 | 2 | 2 |
| CO2 | 3 | 2 | 2 | 2 | 1 | 1 | - | - | - | - | 1 | 1 | 3 | 2 | 3 |
| CO3 | 3 | 3 | 3 | 2 | 2 | 2 | - | - | - | - | 2 | 1 | 2 | 3 | 2 |
| CO4 | 3 | 2 | 3 | 3 | 2 | 2 | 2 | - | 2 | - | 2 | 2 | 3 | 3 | 3 |
| CO5 | 3 | 3 | 3 | 3 | 3 | 3 | 2 | - | 2 | 2 | 3 | 2 | 2 | 3 | 1 |

# MEH103 (R20): ALTERNATIVE ENERGY SOURCES FOR AUTOMOBILES

*II Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

1) To Understanding the basics of alternative energy sources
2) To impart Familiarity with different alternative energy sources impart the necessity of finding alternative energy sources for automobiles.
3) To understand merits and demerits, performance characteristics of various sources of fuels and their comparison.
4) Evaluation of alternative energy systems.

## COURSE OUTCOMES:

By the end of this course, students will be able to

★ Student will possess a comprehensive understanding of available alternative fuels for IC engines.
★ students will posses complete knowledge on producing different biofuels, modifying them and using them in IC engines
★ Students will acquire the skills in developing new technologies for alternative fuels efficiently in IC engines.
★ Students will demonstrate the importance of using alternative fuels for sustainable energy supply and for emission control in IC engines.
★ Students will develop alternative fuel resources for sustainable energy supply and for emission control in IC engines

**Unit-I**

**CONVENTIONAL FUELS FOR I.C. ENGINES**

Petroleum based conventional fuels for SI and CI engine, Demand and Availability of crude oil –vehicle population increase –national and international standards for conventional and alternative fuels.Desirable characteristics of SI Engine fuels –Petrol –Properties, Specification, chemical structure, Volatility characteristics, knock rating and additives. Desirable characteristics of CI Engine fuels –Diesel –Properties, Specification, chemical structure, Ignition quality, Cetane rating and additives.

**Unit-II**

**ALCOHOLS AS FUELS**

Availability of different alternative fuels for engines. Alcohols –Properties, Production methods and usage in engines. Blending, dual fuel operation, surface ignition, spark ignition and oxygenated additives. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of alcohol fuels

**Unit-III**

**VEGETABLE OILS AND BIODIESEL AS FUELS**

Properties of Vegetable oils and biodiesel-Methods of using vegetable oils –Blending, preheating, and emulsification –Preparation of biodiesel from non-edible, edible oil and Algae -Performance, combustion and emission Characteristics in diesel engines. Advantages and disadvantages of Vegetable oils and biodiesel

**Unit-IV**

**HYDROGEN AS FUEL**

Hydrogen –Properties, Production methods, storage and safety aspects. Issues & limitation in Hydrogen. Methods of using hydrogen in engines. Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Hydrogen fuel.

**Unit-V**

**BIOGAS, CNG AND LPG AS FUELS**

Biogas, Compressed Natural gas (CNG) and LPG –Properties and production methods. CO2 and H2S scrubbing in Biogas, Modifications required for use in Engines-Performance, combustion and emission Characteristics in engines. Advantages and disadvantages of Gaseous fuels. Working of LPG and CNG kits used in automotive engines.

## REFERENCE BOOKS:

1) Arumugam S. Ramadhas, “Alternative Fuels for Transportation” CRC Press, 2011.
2) Ayhan Demirbas and M. Fatih Demirbas, “Algae Energy-Algae as a New Source of Biodiesel”, Springer-Verlag London Limited 2010.
3) Ayhan Demirbas, ‘Biodiesel A Realistic Fuel Alternative for Diesel Engines’, Springer-Verlag London Limited 2008
4) David M. Mousdale, “Introduction to Biofuels”, CRC Press, 2015.
5) Ganesan.V., “Internal Combustion Engineering”, Tata McGraw-Hill Publishing Co., New Delhi, 2003.
6) Gerhard Knothe, Jon Van Gerpen, Jargon Krahl, The Biodiesel Handbook, AOCS Press Champaign, Illinois 2005.
7) M. K. Gajendra Babu and K. A. Subramanian, “Alternative Transportation Fuels-Utilisation in Combustion Engines”, CRC Press, 2013.
8) M.L. Mathur, R.P.Sharma “A course in internal combustion engines”, Dhanpatrai publication, 2003.

9) Richard L Bechtold P.E., Alternative Fuels Guide book, Society of Automotive Engineers, 1997 ISBN 0-76-80-0052-1.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | | 2 | 1 | | 1 | 3 | 2 | 1 |
| **CO2** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | | 2 | 1 | | 2 | 3 | 2 | 2 |
| **CO3** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | | 2 | 1 | | 2 | 3 | 2 | 2 |
| **CO4** | 3 | 3 | 3 | 2 | 1 | 2 | 3 | | 2 | 1 | | 3 | 3 | 2 | 3 |
| **CO5** | 3 | 3 | 2 | 1 | 1 | 2 | 3 | | 2 | 1 | | 2 | 2 | 3 | 2 |

# MEH104 (R20): VEHICLE BODY ENGINEERING

*II Year B.Tech.. (Mech.) Second Semester*

| | | | | |
|---|---|---|---|---|
| *Lectures / Tutorials* | *:* | **3 Periods / week** | *Sessional Marks* | **: 30** |
| *University Exam.* | *:* | **3 hrs.** | *University Exam. Marks* | **: 70** |

## COURSE OBJECTIVES:

- Familiarize students with different types of car bodies, their design criteria, and construction processes and provide an understanding of visibility and safety considerations in car body design and the methods to improve them.
- Introduce students to the principles of vehicle aerodynamics and its impact on vehicle performance.
- Explore the design and construction details of bus bodies, including layout, construction techniques, and regulations.
- Discuss the details and considerations specific to commercial vehicle bodies, such as different body types and driver's cab design.
- Provide knowledge about materials, trim, and mechanisms used in automotive body construction, including corrosion prevention and painting processes.

## COURSE OUTCOMES:

1) Identify and classify different types of car bodies and understand their design and construction requirements and evaluate and propose improvements in visibility and safety features of car bodies.
2) Analyze the aerodynamic aspects of vehicle design and apply optimization techniques for reducing drag.
3) Understand the design and construction principles of bus bodies, considering layout, regulations, and construction methods.
4) Comprehend the specific requirements and design considerations for commercial vehicle bodies.
5) Select appropriate materials and mechanisms for automotive body construction, considering durability, functionality, and aesthetic aspects and apply corrosion prevention methods for automotive bodies.

### UNIT- I

CAR BODY DETAILS

Types: saloon, convertibles, limousine, estate car, racing and sports car. Visibility: regulations, driver’s visibility, tests for visibility, methods of improving visibility and space in cars. Safety: safety design, safety equipments for cars. Car body construction; design criteria, prototype making, initial tests, crash tests on full scale model, Dummies and Instrumentation

**UNIT-II**

VEHICLE AERODYNAMICS

Objectives: Vehicle drag and types; various types of forces and moments, effects of forces and moments, side wind effects on forces and moments, Various body optimization techniques for minimum drag, wind tunnel testing: flow visualization techniques, scale model testing, component balance to measure forces and moments.

**UNIT- III**

BUS BODY DETAILS

Types: mini bus, single decker, double-decker, two level and articulated bus. Bus body layout; floor height, engine location, entrance and exit location, seating dimensions. Constructional details: frame construction, double skin construction, types of metal sections used, Regulations, Conventional and integral type construction.

**UNIT-IV**

COMMERCIAL VEHICLE DETAILS

Types of body; flat platform, drop side, fixed side, tipper body, tanker body, Light commercial vehicle body types. Dimensions of driver's seat relation to controls. Drivers cab design.

**UNIT –V**

BODY MATERIALS, TRIM AND MECHANISMS

Steel sheet, timber, plastic, GRP, properties of materials; Corrosion, anticorrosion methods. Selection of paint and painting process. Body trim items. Body mechanisms.

## TEXT BOOK:

1) J.Powloski - "Vehicle Body Engineering" - Business Books Ltd, London -1989

## REFERENCE BOOKS:

1) Giles.J.C. - "Body construction and design" - Liiffe Books Butterworth & Co. - 1971.
2) John Fenton - "Vehicle Body layout and analysis" - Mechanical Engg. Publication Ltd., London – 1982.
3) Braithwaite. J.B. - "Vehicle Body building and drawing" - Heinemann Educational Books Ltd., London – 1977.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 3 | 2 | | | 1 | | | | | | | 1 | 2 | 3 |
| **CO2** | 1 | 3 | 1 | | | 1 | | | | | | | 1 | 2 | 2 |
| **CO3** | 1 | 3 | 2 | | | 1 | | | | | | | 1 | 1 | 3 |
| **CO4** | 1 | 3 | 2 | | | 1 | | | | | | | 1 | 2 | 1 |
| **CO5** | 1 | 3 | 2 | | | 1 | | | | | | | 1 | 1 | 1 |

# MEH201 (R20): FIELD & SERVICE ROBOTICS

*III Year B.Tech.. (Mech) First Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- Understanding the principles of robotic systems for use in field and service applications.
- Knowledge of the design and implementation of robotic systems for use in outdoor environments, and the ability to evaluate their performance and effectiveness.
- Ability to analyze and solve problems related to the design, deployment, and operation of robotic systems in field and service applications.
- Familiarization with the different types of robots used in field and service applications, such as ground, aerial, and underwater robots, and their associated sensors and actuators.
- Ability to communicate effectively and professionally about field and service robotics, including oral presentations, technical reports.

## COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

- ★ Ability to understand and explain the principles and concepts of robotic systems used in field and service applications.
- ★ Ability to analyze and evaluate the performance and effectiveness of robotic systems in outdoor environments.
- ★ Ability to apply software tools and algorithms used in field and service robotics, including mapping, localization, path planning, and navigation.
- ★ Familiarization with the different types of robots used in field and service applications, such as ground, aerial, and underwater robots, and their associated sensors and actuators.
- ★ Ability to work effectively in teams to design, implement, and test robotic systems for field and service applications.

UNIT I-INTRODUCTION

History of service robotics- Present status and future trends-Need for service robots-applications–eamples and specifications of service and field Robots. Non-Conventional Industrial robots.

Unit II

Localization

Introduction-Challenges of Localization- Map Representation- Probabilistic Map based LocalizationMonte carlo localization- Landmark based navigation-Globally unique localization- Positioning beacon systems- Route based localization.

Unit III

Planning and Navigation

Introduction-Path planning overview- Road map path planning- Cell decomposition path planningPotential field path planning-Obstacle avoidance – Case studies: tiered robot architectures.

Unit IV

Ariel robots-Collision avoidance-Robots for agriculture, mining, exploration, underwater, civilian and military applications, Space applications

Unit V

Humanoids:

Wheeled and legged, Legged locomotion and balance, Arm movement, Gaze and auditory orientation control, Facial expression, Hands and manipulation, Sound and speech generation, Motion capture/Learning from demonstration, Human activity recognition using vision, touch, sound, Vision, Tactile Sensing, Models of emotion and motivation. Performance, Interaction, Safety and robustness, Applications, Case studies.

## TEXT BOOKS:

1) Roland Siegwart, Illah Reza Nourbakhsh, Davide Scaramuzza, Introduction to Autonomous Mobile Robots, Bradford Company Scituate, USA, 2004
2) Riadh Siaer, The future of Humanoid Robots- Research and applications", Intech Publications, 2012.

## REFERENCE BOOKS:

1) Richard D Klafter, Thomas A Chmielewski, Michael Negin, "Robotics Engineering – An Integrated Approach", Eastern Economy Edition, Prentice Hall of India P Ltd., 2006.
2) Kelly, Alonzo; Iagnemma, Karl; Howard, Andrew, "Field and Service Robotics", Springer, 2011

# MEH202 (R20): MECHATRONICS

*III Year B.Tech.. (Mech) First Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- Understand the key elements of mechatronics systems and represent them in block diagrams.
- Understand the concept of transfer function, reduction, and analysis.
- Understand the principles of sensors, their characteristics, and interfacing with DAQ microcontrollers.
- Understand the concept of PLC system and its ladder programming, and significance of PLC systems in industrial applications.
- Understand system modeling and analysis in time domain and frequency domain.
- Understand control actions such as Proportional, Derivative, and Integral and study their significance in industrial applications.

## COURSE OUTCOMES:

- ★ Upon completion of the course, the student should be able to:
- ★ Identify key elements of mechatronics systems and represent them in block diagrams.
- ★ Understand the concept of signal processing and use of interfacing systems such as ADC, DAC, digital I/O.
- ★ Interfacing sensors, actuators using appropriate DAQ microcontroller.
- ★ Time and frequency domain analysis of system model (for control application).
- ★ PID control implementation on real-time systems.
- ★ Development of PLC ladder programming and implementation of real-life systems

**UNIT – I**

**Introduction to Mechatronics:** sensors & transducers: Introduction, performance terminology, classification of sensors, terminology, classification of sensors, selection of sensors. (5)

**Signal Conditioning:** Introduction data acquisition – Quantizing theory, analog to digital conversion, digital to analog conversion. (5)

**Data Presentation Systems:** Data presentation elements magnetic displays, data acquisition systems, systems measurement, testing and calibration. (5)

**UNIT – II**

**Actuation Systems**: Pneumatic and hydraulic actuation systems, stepper motors. (7)

**System Models:** Modeling of one and two degrees of freedom mechanical, electrical, fluid and thermal systems. Block diagram representations for these systems. (8)

**UNIT– III**

**Dynamic Response** of systems zero order, First order and second order systems. Block diagram representation, Transfer function. Systems in series, Systems with feed back loops, frequency response. (7)

**Closed Loop Controllers:** Continuous and discrete processes, control modes, two step, proportional, derivative, integral, PID controllers. (8)

**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. (7)

**UNIT – V**

**Design:** Designing mechatronics systems, possible design solutions, case studies of mechatronics systems-pick and place robot. (8)

## TEXT BOOK:

1) Mechatronics by W.Bolton (Pearson)

## REFERENCE BOOKS:

1) Mechatronics by Mahalik
2) Introduction to Mechatronics – David and Alcaitore Michael B.Histand (TMH)
3) Mechanical Measurement – D.S.Kumar.
4) Mechatronics By G.Onwubolu -Elsevier.
5) Mechatronics system Design – Devdasshetty& Richard Kolk (Thomson)

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | | | 1 | | 1 | 3 | 2 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | | | 1 | | 2 | 3 | 2 | 2 |
| CO3 | 3 | 3 | 2 | 2 | 1 | 2 | 1 | | | 1 | | 2 | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 1 | 2 | 1 | | | 1 | | 3 | 3 | 2 | 3 |
| CO5 | 3 | 3 | 2 | 1 | 1 | 2 | 1 | | | 1 | | 2 | 2 | 3 | 2 |

# MEH203 (R20): CONTROL SYSTEMS

*III Year B.Tech.. (Mech) First Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- Understand the fundamental concepts of control systems and differentiate between open loop and closed loop control systems and apply block diagram algebra to analyze and determine transfer functions from block diagrams.
- Analyze the time response of control systems using standard test signals, and evaluate transient and steady-state responses, as well as steady-state errors.
- Investigate stability analysis in the s-domain using Routh-Hurwitz's stability criterion and root locus technique.
- Explore frequency response analysis techniques, including Bode plots and polar plots, to assess system stability and determine phase margin and gain margin.
- Understand the fundamental concepts of State Space Analysis of Continuous Systems state

## COURSE OUTCOMES:

- ★ Identify and classify control systems as open loop or closed loop, and provide examples of each and apply block diagram algebra to determine transfer functions.
- ★ Analyze the time response characteristics of first and second order control systems and calculate steady-state errors and error constants.
- ★ Assess the stability of control systems using Routh-Hurwitz's stability criterion and construct root loci.
- ★ Analyze frequency response characteristics of control systems using Bode plots and polar plots, and determine phase margin and gain margin.
- ★ Understand the concepts of state, state variables, and state models in continuous systems.

## UNIT – I

Introduction: Concept of control system, Classification of control systems – Open loop and closed loop control systems, Differences, Examples of control systems- Effects of feedback, Feedback Characteristics. Transfer Function Representation: Block diagram algebra, Determining the Transfer function from Block Diagrams, Signal flow graphs (SFG) – Reduction using Mason’s gain formula- Transfer function of SFG’s.

**UNIT – II**

Time Response Analysis: Standard test signals, Time response of first order systems, Characteristic Equation of Feedback control systems, Transient response of second order systems – Time domain specifications, Steady state response, Steady state errors and error constants.PID controllers: Effects of proportional derivative, proportional integral systems on steady state error.

**UNIT – III**

Stability Analysis in S-Domain: The concept of stability – Routh-Hurwitz's stability criterion – qualitative stability and conditional stability – Limitations of Routh-Hurwitz's stability. Root Locus Technique: Concept of root locus – Construction of root locus.

**UNIT – IV**

Frequency Response Analysis: Introduction, Frequency domain specifications, Bode plot diagrams-Determination of Phase margin and Gain margin, Stability analysis from Bode plots, Polar plots.

**UNIT – V**

State Space Analysis of Continuous Systems: Concepts of state, state variables and state model, Derivation of state models from block diagrams, Diagonalization, Solving the time invariant state equations, State Transition Matrix and it's properties, Concepts of Controllability and observability.

## REFERENCE BOOKS:

1) Control Systems Theory and Applications – S. K. Bhattacharya, Pearson.
2) Control Systems Engineering – S. Palani, TMH.
3) Control Systems – N. K. Sinha, New Age International (P) Limited Publishers.
4) Control Systems by S.Hasan Saeed, KATSON BOOKS.
5) Solutions and Problems of Control Systems by A.K. Jairath, CBS Publishers.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 3 | 2 | | | | | | | | | | 1 | 2 | 3 |
| **CO2** | 1 | 3 | 1 | | | | | | | | | | 1 | 2 | 2 |
| **CO3** | 1 | 3 | 3 | | | | | | | | | | 1 | 1 | 3 |
| **CO4** | 1 | 3 | 2 | | | | | | | | | | 1 | 2 | 2 |
| **CO5** | 1 | 3 | 3 | | | | | | | | | | 1 | 1 | 1 |

# MEH204 (R20): CAD/CAM

*III Year B.Tech.. (Mech) First Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- The course aims to teach students the basic concepts of CAD/CAM, including computer-aided design, manufacturing, and engineering analysis. Students learn how to use CAD/CAM software to design and simulate parts and assemblies, generate tool paths, and manufacture parts.
- The course provides students with hands-on experience in using CAD/CAM software to design and manufacture parts..
- The course presents students with various real-world problems related to design and manufacturing, such as how to optimize a part design for manufacturing or how to troubleshoot a machining operation.
- The course provides an opportunity for students to work together on CAD/CAM projects, allowing them to practice collaboration and teamwork skills that are essential in many engineering settings.
- The course aims to teach students how to use CAD/CAM software to increase productivity and efficiency in the design and manufacturing process.

## COURSE OUTCOMES:

- ★ Understand geometric transformation techniques in CAD.
- ★ Develop mathematical models to represent curves and surfaces.
- ★ Model engineering components using solid modeling techniques.
- ★ Develop programs for CNC to manufacture industrial components.
- ★ To understand the application of computers in various aspects of Manufacturing viz., Design, Proper planning, Manufacturing cost, Layout & Material Handling system.

### UNIT – I

Fundamentals of CAD/ CAM, Application of computers for Design and Manufacturing, Benefits of CAD/ CAM – Computer peripherals for CAD/ CAM, Design workstation, Graphic terminal, CAD/ CAM software- definition of system software and application software, CAD/ CAM database and structure. Geometric Modeling: Wire frame modeling, wire frame entities, Interpolation and approximation of curves, Concept of parametric and non-parametric representation of curves, Curve fitting techniques, definitions of cubic spline, Bezier, and B-spline.

**UNIT – II**

Surface modeling: Algebraic and geometric form, Parametric space of surface, Blending functions, parametrization of surface patch, Subdividing, Cylindrical surface, Ruled surface, Surface of revolution Spherical surface, Composite surface, Bezier surface.

B-splinesurface, Regenerativesurface and pathological conditions.

Solid Modelling: Definition of cell composition and spatial occupancy enumeration, Sweep representation, Constructive solid geometry, Boundary representations.

**UNIT – III**

NC Control Production Systems: Numerical control, Elements of NC system, NC part programming: Methods of NC part programming, manual part programming, Computer assisted part programming, Post Processor, Computerized part program, SPPL (A Simple Programming Language). CNC, DNC and Adaptive Control Systems.

**UNIT – IV**

Group Technology: Part families, Parts classification and coding. Production flow analysis, Machine cell design.

Computer aided process planning: Difficulties in traditional process planning, Computer aided process planning: retrieval type and generative type, Machinability data systems. Computer aided manufacturing resource planning: Material resource planning, inputs to MRP, MRP output records, Benefits of MRP, Enterprise resource planning, Capacity requirements planning

**UNIT – V**

Flexible manufacturing system: F.M.S equipment, FMS layouts, Analysis methods for FMS benefits of FMS.

Computer aided quality control: Automated inspection- Off-line, On-line, contact, Non-contact; Coordinate measuring machines, Machine vision.

Computer Integrated Manufacturing: CIM system, Benefits of CIM

## TEXT BOOKS:

1) CAD/CAM Concepts and Applications / Alavala / PHI
2) CAD/CAM Principles and Applications / P. N. Rao / Mc Graw Hill

## REFERENCE BOOKS:

1) CAD/CAM/ Groover M.P/ Pearson
2) CAD/CAM/CIM/ Radhakrishnan and Subramanian / New Age

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 3 | 3 | 2 | 2 | | | | | | 2 | 3 | 2 | 2 |
| **CO2** | 3 | 3 | 3 | 3 | 3 | 3 | | | | | | 3 | 2 | 2 | 2 |
| **CO3** | 3 | 3 | 3 | 2 | 3 | 2 | | | | | | 3 | 3 | 2 | 3 |
| **CO4** | 3 | 3 | 3 | 3 | 3 | 2 | | | | | | 2 | 3 | 3 | 2 |
| **CO5** | 3 | 3 | 3 | 2 | 2 | 3 | | | | | | 2 | 3 | 2 | 2 |

# MEH301 (R20): COMPUTATIONAL FLUID DYNAMICS

*III Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To know the various applications of CFD and basic governing equations of fluid flow
- To know the classification of PDE and discretization techniques
- To know the implicit and explicit methods and VN stability criteria for parabolic and hyperbolic equations
- To know different CFD techniques
- To Know the Commercial CFD software packages and applications of CFD.

## COURSE OUTCOMES:

1) Understand the philosophy of CFD and derive governing equations of fluid flow
2) Understand the principles of discretization.
3) Formulate solution techniques for parabolic and hyperbolic equations.
4) Apply some of the popular FD techniques in the solution of fluid flow problems
5) Utilize Commercial CFD software packages to solve fluid flow problems.

UNIT-I

Importance and applications of CFD, Models of flow, governing equations of fluid flow – Navier Stokes and Euler's equations: Continuity, Momentum and Energy equations in differential form, Physical boundary conditions

UNIT-II

Classification of partial differential equations, Discretization techniques- FDM, FEM, FVM,

Finite Difference equations- Taylor series, order of accuracy, forward, backward and central differences for first order and second order differential equations.

UNIT -III

Difference equations, Explicit and Implicit approaches, Thomas Algorithm (TDMA). Analysis of stability, VN stability criteria for parabolic (1-D unsteady heat equation) and Hyperbolic (1st order wave equation) equations, Courant number.

UNIT -IV

Simple CFD techniques: Lax-Wendroff technique, MacCormack's technique and Iterative and Relaxation techniques.

UNIT -V

Pressure correction technique, staggered grid, SIMPLE algorithm, Boundary conditions for pressure correction method. Commercial CFD software packages and applications of CFD.

## TEXT BOOK(S):

1) Computational Fluid Dynamics - Basics with Applications - John. D. Anderson, JR. McGraw Hill Education (India) Edition2012.
2) Computational Fluid Dynamics - T. J. Chung, Cambridge University Press, 2nd Edition, 2014.

## REFERENCE BOOK(S):

1) Introduction to computational fluid mechanics - Niyogi, Chakravarty, Laha, Pearson pub. 1st Edition, 2009.
2) Numerical heat transfer and fluid flow - S.V. Patankar, Hemisphere Pub., 1stEdition.
3) Computational Fluid flow and Heat transfer - K. Muralidhar and T. Sundararajan-, Narosa Pub. 2nd Edition,2003.

## WEB REFERENCE:

1) http://ocw.mit.edu/courses/mecharlical-engineering/2-29 numerigalfluidmechanicsfall 2011/
2) http:/inptel.ac.in/courses/112105045/ (IIT Kharagpur)
3) http://nptel.ac.in/courses/112107080/ (IIT Roorkee)
4) http://nptel.ac.in/courses/112104030/ (IIT Kanpur)

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO2** | 2 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO3** | 2 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO4** | 2 | 3 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO5** | 2 | 3 | 1 | | 1 | | | | | | | | 1 | 2 | 3 |

# MEH302 (R20): GAS DYNAMICS & JET PROPULSIONS

*III Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To understand the behaviour of compressible fluid & Governing equations.
- To understand the Non-isentropic flow behaviour.
- To understand the principle of Jet Propulsion and Working Principles of various jet engines.
- To understand the working principle of rocket engine and its propellants.

## COURSE OUTCOMES:

- ★ Able to analyse the isentropic compressible flow systems.
- ★ Able to understand Subsonic and supersonic flow
- ★ Able to analyse the non-isentropic compressible flow.
- ★ Able to estimate the Thrust, Power and various efficiencies of Jet Propulsion units.
- ★ Able to analyse the rocket engines

UNIT-I

Compressible flow, definition, Mach waves and Mach cone, stagnation states, Mass, momentum and energy equations of one-dimensional flow, Isentropic flow through variable area ducts, nozzle s and diffusers.

UNIT-II

Subsonic and supersonic flow I variable area ducts, choked flow, Area-Mach number relations for isentropic flow. Applications, advantages and disadvantages of Supersonics and Subsonic flows

UNIT-III

Non-isentropic flow in constant area ducts, Rayleigh and Fanno flows, Normal shock relations, oblique shock relations, isentropic and shock tables.

UNIT -IV

Theory of jet propulsion, thrust equation, thrust power and propulsive efficiency, Operating principle and cycle analysis of ramjet, turbojet, turbofan and turboprop engines.

UNIT -V

Types of rocket engines, propellants & feeding systems, ignition and combustion, theory of rocket propulsion, performance study, staging, terminal and characteristic velocity, space flights.

## TEXT BOOKS:

1) Gas Dynamics and Jet Propulsion - P.L.Somasundaram
2) Gas Dynamics - E.Radhakrishnan

## REFERENCE BOOKS:

1) Gas Dynamics - JohnJames
2) Fundamentals of Gas Dynamics - Chen, Recey Hung

## WEB REFERENCES:

1) https://lecturenotes.in/video-tutorial/63871-gas-dynamics-andpropulsion?reading=true
2) https://www.youtube.com/watch?v=2INUkeutjBY&list=PLbMVogVj5nJR0V t9CLGK7ck2yrS1zQjMo
3) https://www.youtube.com/watch?v=lPoU8Cu9ffw&list=PLY6be7r7PT8Jec
4) yts018SmNqWPMA-JpQA
5) https://www.youtube.com/watch?v=csxn_ek8HSE
6) https://www.youtube.com/watch?v=xSpqILSumek

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 1 | 1 | | | | | | | | | | 1 | 2 | 3 |
| **CO2** | 1 | 3 | 1 | | | | | | | | | | 1 | 2 | 1 |
| **CO3** | 2 | 3 | 1 | | | | | | | | | | 1 | 3 | 3 |
| **CO4** | 1 | 1 | 1 | | | | | | | | | | 2 | 2 | 3 |
| **CO5** | 2 | 1 | 1 | | | | | | | | | | 1 | 3 | 3 |

# MEH303 (R20): ALTERNATE FUELS & ENERGY SYSTEMS

*III Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To know about the different fuels and the required qualities to use as engine fuels, potential alternative fuels, their merits and demerits.
- To understand the need for alternative fuels.
- To know the availability of different alternative fuels for both SI and CI engines and the suitability of alcohols as fuels for both SI and CI engines.
- To know about the suitability of Hydrogen as a fuel for both SI and CI engines, different production methods along with storage and safety aspects of Hydrogen and to know about the different vegetable oils suitable as fuels
- To know about the working of electric, hybrid and fuel cell vehicles.

## COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

- ★ Understanding the basic principles and concepts of alternative fuels and energy systems, including their properties, production methods, and applications.
- ★ Familiarization with the different types of alternative fuels and energy systems, such as biofuels, hydrogen fuel etc.
- ★ Ability to evaluate the performance, efficiency, and environmental impact of alternative fuels and energy systems.
- ★ Knowledge of the policy and regulatory frameworks that govern the development and deployment of alternative fuels and energy systems.
- ★ Ability to design and optimize energy systems that integrate multiple alternative fuels

UNIT-I

Introduction: solid fuels, gases fuels, liquid fuels, petroleum refining process, important requisite qualities of engine fuels, SAE rating of fuels. FUELS: Availability and Suitability to Piston Engines. Concept of conventional fuels, potential alternative fuels - Ethanol, Methanol, DEE/DME.

UNIT-II

Hydrogen, LPG, Natural gas, Producer gas, Bio gas and Vegetable oils - Use in I.C.Engines-Merits and Demerits of various fuels. Application, advantages & Disadvantages of alternate fuels.

UNIT-III

Introduction to alternative fuels. - Need for alternative fuels - Availability of different alternative fuels for SI and CI engines. Alcohols as fuels. Production methods of alcohols. Properties of alcohols as fuels. Methods of using alcohols in CI and SI engines. Blending, dual fuel operation, surface ignition and oxygenated additives.

UNIT-IV

GASEOUS FUELS: Hydrogen - Properties - Use in C.I Engines - Use in S.I Engines - Storage methods - Safety precautions -Production methods. LPG & Natural gas - Properties - Use in S.I. and C.I. Engines. VEGETABLE OILS: Properties - Esterification - Performance in Engines.

UNIT-V

ELECTRIC, HYBRID AND FUEL CELL VEHICLES Layout of Electric vehicle and Hybrid vehicles – Advantages and drawbacks of electric and hybrid vehicles. System components, Electronic control system – Different configurations of Hybrid vehicles. Power split device. High energy and power density batteries – Basics of Fuel cell vehicles.

## TEXT BOOKS:

1) S.S. Thipse, "Alternative Fuels", Jaico Publishing House; First edition, 2010.
2) Erjavec Jack Et.Al, "Alternative Fuel Technology: Electric, Hybrid, and Fuel-Cell Vehicles", Cengage Learning, 2007.

## REFERENCE BOOKS:

1) Ganesan. V. "Internal Combustion Engines", Tata McGraw-Hill Publishing Co., 2012.
2) Mathur D.S., Sharma. R.P. "A course in internal combustion engines", Dhanpatrai publication, 2014.

## WEB REFERENCES:

1) https://scholarworks.umt.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1296&context=syllabi
2) NPTEL-https://nptel.ac.in/courses/121/106/121106014/
3) https://nptel.ac.in/content/storage2/courses/112104033/pdf_lecture/lecture39.pdf

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | | | | | 1 | 3 | 2 | |
| **CO2** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | | | | | 2 | 3 | 2 | |
| **CO3** | 3 | 3 | 2 | 2 | 1 | 2 | 2 | | | | | 2 | 3 | 2 | |
| **CO4** | 3 | 3 | 3 | 2 | 1 | 2 | 2 | | | | | 3 | 3 | 2 | |
| **CO5** | 3 | 3 | 2 | 1 | 1 | 2 | 2 | | | | | 2 | 2 | 3 | |

# MEH304 (R20): SAFETY ASPECTS OF NUCLEAR POWER PLANTS

*III Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

This course enables the students to:

1) Familiarize the students on the future benifits of Nuclear power plants.
2) Develop an intuitive understanding of safety of Nuclear power plants
3) Study the regulatory approaches adopted, which assures the safety of NPP.

## COURSE OUTCOMES:

At the end of the course, a student should be able to:

1) Outline the basic concept of Nuclear reactors.
2) Analyse the various Radiation sources and Protection of NPP
3) Analyze the safety principles.
4) Evaluate and Analyze some events in NPP and Sitings of Nuclear plants
5) Analyze the safety regulations in India.

UNIT-I

Introduction: Energy sources, Nuclear Power Production, medical and Societal applications of radiation, Nuclear fuel cycle. Basic Physics of Nuclear Reactors: Atomic Structure, isotopes, Radioactivity, half life, Basics of fission reaction, Moderation, Criticality, Decay heat, Reactivity and Feedback, Breeding.

UNIT-II

Nuclear Reactor Types: Components of Nuclear Reactor, Present Reactor Types, Generation IV Concepts. Radiation sources and Protection: Radiation and its units, Natural background and manmade Radiation, Biological Effects, Exposure limits and protection, Sources of radiation, shielding.

UNIT-III

Safety Principles and approach: Safety objectives, Defence in depth philosophy, Multiple barriers, Rad-waste management, Levels of defence, Redundancy, Diversity Principles, Event analysis, core inventory, emergency response. Deterministic approach- Design Basis Events & Beyond Design Basis Events, Acceptance Criteria, Probabilistic approach- Fault tree, event tree, failure rates. Engineered Safety Systems: Shutdown systems in PWR, BWR, PHWR, Reactivity Worth of shutdown system, Trip Signals, Safety Logic, Operating Environment, Grouping of safety systems, Heat Removal systems, Emergency Core Cooling, Containment and subsystems.

UNIT-IV

Analysis of Some Events in NPP: Heat transfer and Fluid flow prediction, validation, Safety set points, Safety actions for events, Spurious opening of Pressuriser valve in a PWR, LOCA analysis Indian PHWR, Station Blackout without Reactor Trip, FBTR. Siting of Nuclear plants: Site evaluation Stages, Site Rejection Criteria, Earthquake, Geological criteria, Meteorological considerations, Flooding, Tsunami, Shoreline erosion, chemical explosion, Radiological impact study, Radioactivity pathways to humans, environmental Impact study. (

UNIT-V

Safety Regulation In India: Atomic Energy Regulatory Board, functions, safety Documents, Safety Review of site, design, regulatory inspections, safety review for PFBR, Koodankulam, Regulatory review of operating plants, Licensing stages, licensing of operating personnel, Training simulator, safety up-gradation Review after TMI Chernobyl, Review after Fukushima, safety review for decommissioning, Safety Review of Radiation Facilities, medical X-ray units, Gamma irradiators.

## TEXT BOOK:

1) G. Vaidyanathan, Nuclear reactor Safety- principles and concept, Yes Dee Publishing, 2017.

## REFERENCE BOOKS:

1) Samuel Glasstone, Nuclear Reactor Engineering, CBS Publishers & Distributors, 2004.
2) John R. Lamarsh, Introduction to Nuclear Engineering, Pearson Education India, 2014.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 2 | | | | | | | | | | 3 | 2 | 1 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 3 | 2 | 2 |
| CO3 | 1 | 1 | 2 | | | | | | | | | | 3 | 2 | 2 |
| CO4 | 3 | 3 | 3 | | | | | | | | | | 3 | 2 | 3 |
| CO5 | 3 | 2 | 2 | | | | | | | | | | 2 | 3 | 2 |

# MEH401 (R20): ADDITIVE MANUFACTURING

*IV Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To provide the basics of Additive manufacturing Process
- To give an idea of Reverse Engineering concept in the present scenario.
- To provide knowledge on types of Additive manufacturing techniques
- To introduce to and development of new tooling techniques for manufacturing.

**COURSE OUTCOMES:** The students will be able to

- ★ Understand concepts and terminology of additive manufacturing
- ★ Apply the reverse engineering concepts for design development
- ★ Understand the variety of additive manufacturing techniques
- ★ Design and develop newer tooling models
- ★ Understand the Powder Based Additive Manufacturing System:

UNIT-I

Introduction: Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM -Classification of AM processes-Advantages and Applications.

UNIT-II

Reverse Engineering and CAD Modeling: Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation- Software for AM.

UNIT-III

Tooling: Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling. Liquid Based Additive Manufacturing System: Stereo-lithography Apparatus (SLA): Principle, pre- build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, recoats issues, materials, advantages, limitations and applications.

UNIT-IV

Solid Based Additive Manufacturing System: Solid Ground Curing (SGC): working principle, process, strengths, weaknesses and applications. Fused deposition Modeling (FDM)-Principle, details of process, process variables, products, materials and applications. Laminated Object Manufacturing (LOM)-Working Principle, Details of processes, materials, advantages, limitations and applications.

UNIT-V

Powder Based Additive Manufacturing System: Selective Laser Sintering (SLS)-Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS)-Processes, materials, advantages, limitations, Applications.

## REFERENCE BOOKS:


1) Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.
2) Gebhardt, A., "Rapid prototyping", Hanser Gardener Publications,2 003.
3) Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
4) Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.14 5. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
5) Liou, L.W. and Liou, F.W., "Rapid Prototyping and Engineering applications: A tool box for prototype development", CRC Press, 2011.


## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 1 | 1 | 2 | | 1 | | | | | | | | 2 | 2 | 1 |
| CO2 | 3 | 3 | 2 | | 1 | | | | | | | | 3 | 3 | 2 |
| CO3 | 1 | 1 | 2 | | 1 | | | | | | | | 2 | 2 | 3 |
| CO4 | 1 | 3 | 1 | | 1 | | | | | | | | 3 | 2 | 3 |
| CO5 | 1 | 2 | 2 | | 1 | | | | | | | | 2 | 3 | 2 |

# MEH402 (R20): SUPPLY CHAIN MANAGEMENT

*IV Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- Understand the basic concepts of Supply Chain Management and identify SC drivers.
- Discuss the role of supply chain network.
- Know the importance of logistics in SCM
- Learn about aggregate planning and coordination concepts of SCM.

## COURSE OUTCOMES:

After completion of the course, the students will be able to

- ★ Understand the decision phases and apply competitive & supply chain strategies.
- ★ Analyze factors influencing network design.
- ★ Analyze the influence of logistics in a supply chain.
- ★ Understand the role of aggregate planning, inventory, IT and coordination in a supply chain
- ★ Understand the Modes of Transportation

UNIT-I

Introduction to Supply Chain Management, Decision phases in a supply chain, Process views of a supply chain: push/pull and cycle views, Achieving Strategic fit, Expanding strategic scope. Supply Chain Drivers and Metrics: Drivers of supply chain performance, Framework for structuring Drivers, Obstacles to achieving strategic fit.

UNIT-II

Designing Supply Chain Network: Factors influencing Distribution Network Design, Design options for a Distribution network, E-Business and Distribution network, Framework for Network Design Decisions, Models for Facility Location and Capacity Allocation.

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.

UNIT-IV

Aggregate Planning and Inventories in SC: Aggregate planning problem in SC, Aggregate Planning Strategies, Planning Supply and Demand in a SC, Managing uncertainty in a SC: Safety Inventory. Coordination in SC:

UNIT-V

Modes of Transportation and their performance characteristics, Supply Chain IT framework, Coordination in a SC and Bullwhip Effect.

## TEXT BOOK(S):

1) Sunil Chopra and Peter Meindl, Supply Chain Management - Strategy, Planning and Operation, 4th Edition, Pearson Education Asia, 2010.
2) David Simchi-Levi, Philp Kamintry and Edith Simchy Levy, Designing and Managing the SupplyChain - Concepts Strategies and Case Studies, 2nd Edition, Tata-McGraw Hill, 2000.

## REFERENCE BOOK(S):

1) Jeremy F.Shapiro, "Modeling the Supply Chain", Thomson Duxbury, 2002.
2) Srinivasan G.S, "Quantitative models in Operations and Supply Chain Management, PHI, 2010
3) David J.Bloomberg, Stephen Lemay and Joe B.Hanna, "Logistics", PHI 2002.
4) James B.Ayers, "Handbook of Supply Chain Management", St.Lucle press, 2000.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | | | | | | | | | | 2 | 1 | 3 |
| CO2 | 3 | 3 | 3 | | | | | | | | | | 3 | 3 | 2 |
| CO3 | 1 | 2 | 2 | | | | | | | | | | 3 | 2 | 3 |
| CO4 | 2 | 3 | 3 | | | | | | | | | | 3 | 3 | 3 |
| CO5 | 1 | 2 | 2 | | | | | | | | | | 1 | 3 | 3 |

# MEH403 (R20): FLEXIBLE MANUFACTURING SYSTEMS

*IV Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- Understanding the concept of FMS.
- Acquires Knowledge of FMS technology
- Design and implementation of FMS
- Optimization of manufacturing processes
- Safety considerations

## COURSE OUTCOMES:

Upon completion of the course, the student should be able to:

- ★ Understanding of FMS technology
- ★ Proficiency in FMS software tools
- ★ Design and implementation of FMS
- ★ Optimization of manufacturing processes
- ★ Safety considerations

UNIT I

PLANNING, SCHEDULING AND CONTROL OF FLEXIBLE MANUFACTURING SYSTEMS :Introduction to FMS– development of manufacturing systems – benefits – major elements – types of flexibility – FMS application and flexibility –single product, single batch, n – batch scheduling problem – knowledge based scheduling system.

UNIT II

COMPUTER CONTROL AND SOFTWARE FOR FLEXIBLEMANUFACTURING SYSTEMS :Introduction – composition of FMS– hierarchy of computer control –computer control of work center and assembly lines – FMS supervisory computer control – types of software specification and selection – trends.

UNIT III

FMS SIMULATION AND DATA BASE: Application of simulation–model of FMS– simulation software – limitation – manufacturing data systems–data flow–FMS database systems–planning for FMS database.

UNIT IV

GROUP TECHNOLOGY AND JUSTIFICATION OF FMS: Introduction – matrix formulation – mathematical programming formulation –graph formulation – knowledge based system for group technology – economic justification of FMS- application of possibility distributions in FMS systems justification.

UNIT V

APPLICATIONS OF FMS AND FACTORY OF THE FUTURE: FMS application in machining, sheet metal fabrication, prismatic component production –aerospace application – FMS development towards factories of the future – artificial intelligence and expert systems in FMS – design philosophy and characteristics for future.

## TEXT BOOK:

1) Jha, N.K. "Handbook of flexible manufacturing systems", Academic Press Inc.,1991.

## REFERENCE BOOKS:

1) Radhakrishnan P. and Subramanyan S., "CAD/CAM/CIM", Wiley Eastern Ltd., New Age International Ltd., 1994.
2) Raouf, A. and Ben-Daya, M., Editors, "Flexible manufacturing systems: recent development", Elsevier Science, 1995.
3) Groover M.P., "Automation, production systems and computer integrated manufacturing", Prentice Hall of India Pvt., New Delhi, 1996.
4) Kalpakjian, "Manufacturing engineering and technology", Addison-Wesley Publishing Co., 1995.
5) Taiichi Ohno, "Toyota production system: beyond large-scale production", Productivity Press (India) Pvt. Ltd. 1992.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 3 | 2 | 1 | 1 | 1 | 2 | | 2 | 2 | | 1 | 3 | 2 | 1 |
| CO2 | 2 | 2 | 2 | 2 | 1 | 1 | 2 | | 2 | 2 | | 2 | 2 | 2 | 2 |
| CO3 | 2 | 3 | 1 | 2 | 1 | 1 | 2 | | 3 | 2 | | 2 | 3 | 1 | 2 |
| CO4 | 2 | 3 | 2 | 3 | 1 | 1 | 2 | | 2 | 2 | | 3 | 3 | 2 | 3 |
| CO5 | 2 | 3 | 3 | 2 | 1 | 1 | 2 | | 2 | 2 | | 2 | 3 | 3 | 2 |

# MEH404 (R20): RAPID PROTOTYPING

*III Year B.Tech.. (Mech) Second Semester*

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- Understand the fundamentals of rapid prototyping and its historical development and identify and classify different rapid prototyping processes.
- Analyze and evaluate the working principles, specifications, advantages, and limitations of liquid-based rapid prototyping systems and solid-based rapid prototyping systems
- Analyze and evaluate the working principles, specifications, advantages, and limitations of powder-based rapid prototyping systems
- Understand the concept of rapid tooling and differentiate between conventional tooling and rapid tooling methods.
- Explore different rapid tooling classification methods and techniques including indirect rapid tooling and direct rapid tooling and Understand and analyze the data formats particularly the STL format

## COURSE OUTCOMES:

- ★ Identify and classify various rapid prototyping processes and explain their working principles.
- ★ Analyze and compare the specifications, advantages, and limitations of different rapid prototyping systems.
- ★ Analyze and evaluate the working principles, specifications, advantages, and limitations of powder-based rapid prototyping systems
- ★ Evaluate the need for rapid tooling and analyze different methods and techniques used in rapid tooling.
- ★ Demonstrate an understanding of the applications of rapid prototyping in engineering, and apply appropriate data formats and software tools for rapid prototyping and overcome common issues related to STL files.

Unit - I

INTRODUCTION:

Prototyping fundamentals, historical development, fundamentals of rapid prototyping, advantages and limitations of rapid prototyping, commonly used terms, classification of RP process. LIQUID-BASED RAPID PROTOTYPING SYSTEMS: Stereo lithography Apparatus (SLA): models and specifications, process, working principle, photopolymers, photo polymerization, layering technology, laser and laser scanning, applications, advantages and disadvantages, case studies. Solid Ground Curing (SGC): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Unit - II

SOLID-BASED RAPID PROTOTYPING SYSTEMS: Laminated object manufacturing (LOM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies. Fused deposition modeling (FDM) - models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Unit - III

POWDER BASED RAPID PROTOTYPING SYSTEMS: Selective laser sintering (SLS): models and specifications, process, working principle, applications, advantages and disadvantages, case studies. three dimensional printing (3DP): models and specifications, process, working principle, applications, advantages and disadvantages, case studies.

Unit - IV

RAPID TOOLING: Introduction to rapid tooling (RT), conventional tooling Vs RT, Need for RT. rapid tooling classification: indirect rapid tooling methods: spray metal deposition, RTV epoxy tools, Ceramic tools, investment casting, spin casting, die casting, sand casting, 3D Keltool process. Direct rapid tooling: direct AIM, LOM Tools, DTM Rapid Tool Process, EOS Direct Tool Process and Direct Metal Tooling using 3DP.

Unit - V

RAPID PROTOTYPING DATA FORMATS: STL Format, STL File Problems, consequence of building valid and invalid tessellated models, STL file Repairs: Generic Solution, other Translators, Newly Proposed Formats. RAPID PROTOTYPING SOFTWARE'S: Features of various RP software's like Magics, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor

RP APPLICATIONS: Application in engineering, analysis and planning, aerospace industry, automotive industry, jewelry industry, coin industry, GIS application, arts and architecture. RP medical and bioengineering applications: planning and simulation of complex surgery, customized implants & prosthesis, design and production of medical devices, forensic science and anthropology, visualization of bimolecular.

## TEXT BOOK:

1) Rapid prototyping: Principles and Applications - Chua C.K., Leong K.F. and LIM C.S, World Scientific publications.

## REFERENCE BOOKS:

1) Rapid Manufacturing – D.T. Pham and S.S. Dimov, Springer.
2) Wholers Report 2000 – Terry Wohlers, Wohlers Associates.
3) Rapid Prototyping & Manufacturing – Paul F.Jacobs, ASME Press.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 1 | 3 | 2 | | | | | | | | | | 1 | 3 | 3 |
| **CO2** | 2 | 3 | 1 | | 1 | | | | | | | | 1 | 2 | 3 |
| **CO3** | 1 | 3 | 2 | | 1 | | | | | | | | 1 | 3 | 3 |
| **CO4** | 1 | 3 | 1 | | 1 | | | | | | | | 1 | 2 | 3 |
| **CO5** | 2 | 3 | 1 | | 1 | 2 | | | | | | | 1 | 3 | 3 |

# MINOR DEGREE COURSES

# MEM11 (R20): BASIC MECHANICAL SCIENCES

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To teach the students about the Power transmission elements.
- To understand the students familiar on thermodynamics laws.
- To make the students understand on internal Combustion Engines
- To teach the students familiar on types of boiler, pumps and compressors
- To understand the students. Refrigeration & Air Conditioning.

## COURSE OUTCOMES:

At the end of course the students will be able to

- ★ Understand the applications of the thermody0mics to the various real life system
- ★ Students will be able to describe fundamental laws of thermody0mics.
- ★ Students will be able to estimate performance otto cycle and diesel cycle..
- ★ Students will be able to perform air compressors.
- ★ Students will be able to perform working of pumps and the efficiency of engines.

**Unit-I**

**Transmission of Motion and Power**

Introduction, Methods of drive, Power transmission elements, shaft and axle, Belt-drive, Pulleys, Power transmitted by a belt, Chain drive, Friction drive, Gear drive

**Governors**

Introduction, Speed Control, Types of Governors, Watt Governer, Porter Governer, Hartnell Governer.

**Unit – II**

**Basic Thermodynamics:** Work, Power, Energy, Heat, Temperature, Mechanical equivalent of heat, Internal energy, Enthalpy, Entropy, Efficiency, Statements of Zeroth law, First Law and Second Law of Thermodynamics

**Unit – III**

**Internal Combustion Engines**

Introduction, Classification, Engine details, Otto four-stroke cycle, Diesel-four-stroke cycle, Difference between Otto cycle and Diesel cycle, Two-stroke cycle, Difference between two-stroke and four-stroke cycles, Indicated Power (ip), Brake Power (bp),Efficiencies

**Unit – IV**

**Steam Boilers**

Introduction, Classification, Simple vertical boiler, Vertical multi tubular boiler, Cochran type, Lancashire boiler, Locomotive boiler, Babcock and Wilcox boiler, High pressure boilers, Boiler details, Boiler performance. Functioning of different mountings like Pressure guage, Water level indicator, Safety Valve etc. and Accessories like Feed Pump, Injector, Economizer, Steam trap etc.

**Refrigeration & Air Conditioning**

Introduction, Refrigerant, Types of refrigerators, Vapor compression refrigerating system, Window and split-air conditioners.

**Unit – V**

**Pumps**

Introduction, Reciprocating pump types, operation, Air Chamber, Centrifugal pumps types, Priming, Rotary pumps.

**Air Compressors**

Introduction, Uses of Compressed air, Reciprocating compressors, Operation of a compressor, Work for compression, Power required, Reciprocating compressor efficiency, Multistage reciprocating compressors, Rotary compressors.

## TEXT BOOKS:

1) Elements of Mechanical Engineering , by Rajput ,Laxmi Publications, New Delhi
2) Elements of Mechanical Engineering by K.P. Roy , Media Promoters
3) Thermal Engineering – by Rajput, Laxmi Publications, New Delhi
4) Theory of Machines , by R.S. Khurmi& Gupta, S.Chand Publishers
5) Elements of Mechanical Engineering -- by K.P. Roy , Media Promoters

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 2 | 1 |
| CO2 | 3 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 2 | 2 |
| CO3 | 2 | 2 | 2 | 2 | 2 | | | | | | | | 2 | 1 | 2 |
| CO4 | 3 | 3 | 3 | 2 | 2 | | | | | | | | 3 | 2 | 3 |
| CO5 | 2 | 3 | 2 | 2 | 2 | | | | | | | | 2 | 3 | 2 |

# MEM12 (R20): THERMAL ENGINEERING

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To introduce students to the fundamental concepts and definitions of thermodynamics, including thermodynamic systems, equilibrium, processes, and cycles.
- To provide students with an understanding of the first law of thermodynamics for both non-flow and flow systems, including the concepts of internal energy, enthalpy, and energy conservation.
- To familiarize students with the second law of thermodynamics and its applications in heat engines, refrigerators, and the Carnot cycle.
- To introduce students to the properties and behavior of pure substances, including steam generation, phase transformations, and thermodynamic diagrams.
- To explore vapor power cycles, such as the Rankine cycle, and their efficiency and performance characteristics.

## COURSE OUTCOMES:

CO1: Understand and explain the fundamental concepts and definitions of thermodynamics, including thermodynamic systems, equilibrium, and processes.

CO2: Apply the first law of thermodynamics to analyze non-flow systems and understand the principles of energy conservation.

CO3: Apply the first law of thermodynamics to analyze flow systems and understand the principles of energy conservation in control volumes.

CO4: Understand the second law of thermodynamics and its applications in heat engines, properties and behavior of pure substances, including steam generation, phase transformations, and thermodynamic diagrams.

CO5: Analyze and evaluate the performance and efficiency of vapor power cycles, such as the Rankine cycle, with variations in pressure and temperature, Understand the basic principles and laws of heat transfer, including thermal conductivity and steady-state heat conduction.

## 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, reversible and irreversible processes, factors that render a process irreversible, cycle, Zeroth law of thermodynamics, concept of temperature. (8)

**Work and Heat:** Definitions and units, system, closed system, open system, surrounding, universe, Work done at the moving boundary of a system, Work done in various non-flow processes, comparison of heat and work.(4)

**UNIT II**

**First Law of Thermodynamics for Non-Flow Systems:** First law for a system undergoing a cycle and for a change in state of system, internal energy and enthalpy, constant volume and constant pressure specific heats and their relation to internal energy and enthalpy of ideal gases. (8)

**First Law of Thermodynamics for Flow Systems*:*** Control mass and control volume, first law of thermodynamics for a control volume, Steady flow energy equation and itsApplication to engineering equipment. (4)

**UNIT III**

**Second Law of Thermodynamics:** Limitations of first law, PMM of first kind**,** Heat engines and Refrigerators, Statements of Second law, PMM of second kind, Carnot cycle and Carnot theorems, Thermodynamic temperature scale. (8)

**Pure Substance:** Definition**,** process of steam generation, P-v, T-s and h-s diagrams, Properties of saturated and superheated steam, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction (4)

**UNIT IV**

**Vapor Power Cycles:** Rankine cycle, Effect of pressure and temperature on the Rankine cycle, reheat cycle, regenerative cycle. (8)

**Steam Boilers:** Function, classification, working of Babcock and Wilcox boiler, Mountings & Accessories. (4)

**UNIT V**

**Introduction:** Basic Modes and Laws of Heat transfer, thermal conductivity, Steady state Heat Conduction, General conduction equation in Cartesian, Cylindrical and Spherical coordinates, initial and boundary conditions. (5)

**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.(8)

## TEXT BOOKS:

1) Thermal Engineering -Rajput, LaxmiPubl, New Delhi.
2) Thermal Science and Engineering- D.S.kumar, S.K.Kataria Publ, New Delhi.
3) Heat and Mass Transfer – Sachdeva, New Age India, New Delhi
4) Heat Transfer-Rajput, Laxmipubl, New Delhi.

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | | | | | | | | | 1 | 2 | 1 |
| CO2 | 3 | 3 | 2 | | | | | | | | | | 2 | 2 | 2 |
| CO3 | 2 | 1 | 2 | | | | | | | | | | 1 | 1 | 2 |
| CO4 | 3 | 2 | 3 | | | | | | | | | | 3 | 1 | 2 |
| CO5 | 2 | 1 | 1 | | | | | | | | | | 2 | 1 | 2 |

# MEM13 (R20): PRODUCTION TECHNOLOGY

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To introduce students to the fundamental concepts and techniques of metal casting, including the advantages of the casting method, pattern making, sand molding, and core preparation.
- To familiarize students with special casting methods such as permanent mold casting, die casting, centrifugal casting, investment casting, shell molding, CO2 process, and continuous casting.
- To provide an understanding of gating design considerations in metal casting and the fettling process for castings.
- To introduce various welding processes, including gas welding, arc welding, resistance welding, thermit welding, electro slag welding, laser beam welding, brazing, and soldering, along with the causes and remedies of welding defects.
- To explore metalworking processes such as hot and cold working, rolling, forging, extrusion, tube making, swaging, spinning, coining, embossing, wire drawing, explosive forming, and electro-hydraulic forming.

## COURSE OUTCOMES:

CO1: Understand and apply the principles and techniques of metal casting, including pattern making, sand molding, core preparation, and gating design.

CO2: Analyze and evaluate special casting methods, such as permanent mold casting, die casting, centrifugal casting, investment casting, shell molding, CO2 process, and continuous casting.

CO3: Demonstrate proficiency in welding processes, including gas welding, arc welding, resistance welding, thermit welding, electro slag welding, laser beam welding, brazing, and soldering.

CO4: Understand and apply metalworking processes such as rolling, forging, extrusion, tube making, swaging, spinning, coining, embossing, wire drawing, explosive forming, and electro-hydraulic forming.

CO5: Gain knowledge of machining processes and machine tools, including lathe operations, drilling machines, shaping and planning, grinding machines, and surface finishing operations.

## UNIT I

**Metal Casting:** Introduction, advantages of Casting method, pattern: types, materials and allowances. Sand moulding procedure, Moulding materials and equipment. Preparation, control and testing of moulding sands. Cores, Cupola: Description, operation and zones. (12)

**Gating Design**: Design Considerations

**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.(12)

**UNIT- II**

**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- III**

**Metal Working Processes:** Introduction, Hot and Cold working of metals.

**Rolling:**Types of rolling mills, roll passes

**Forging:**Types, description and types of forging, defects in forged parts.

**Extrusion:** Classification, description and application of extrusion process Tube making, Swaging Spinning, Coining, Embossing and Wire drawing

Explosive forming and electro hydraulic forming.(12)

**UNIT- IV**

**Machining Processes and Machine Tools:** Introduction, Primary and Auxiliary Motions in machine tools, parameters defining working motions of a machine tool. (3)

**Lathe:** Constructional details, specifications, classification of lathes**. (3)**

**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. (9)

**UNIT- V**

**Drilling Machines:** Types and specifications, spindle feed mechanism, drilling operations, drilling time. (4)

**Shaping and Planing:** Constructional details, types of shapers and planers, specifications, Quick Return Mechanism and automatic feed mechanisms. (4)

**Grinding Machines:** General Principles, Wheel materials, Selection and specification of grinding wheels, Truing and Dressing of grinding wheels, types of grinding machines. (7)

**Surface Finishing Operations:** Honing and Lapping operations. (3)

## TEXT BOOKS:

1) Manufacturing Technology-Vol- I by PN Rao, TMH
2) Workshop Technology Vol.1 by S.K.Hazra Chowdary. Khanna Publishers
3) A course in Work shop technology, Vol-I by B.S.Raghuvanshi, Dhanpatrai & Sons.
4) Workshop Technology Vol. II by Hazra Chowdary
5) Production Engineering by P.C. Sharma, S.Chand & Co

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 2 | 2 | | | | | | | | | | 1 | 2 | 3 |
| CO2 | 3 | 3 | 2 | | | 1 | | | | | | | 2 | 2 | 2 |
| CO3 | 2 | 1 | 2 | | | | | | | | | | 1 | 1 | 3 |
| CO4 | 2 | 1 | 3 | | | 2 | | | | | | | 3 | 1 | 2 |
| CO5 | 2 | 1 | 1 | | | | | | | | | | 2 | 1 | 3 |

# MEM14 (R20): FUNDAMENTS OF ENGINEERING DESIGN

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To introduce students to the fundamental concepts of mechanisms and machines, including rigid and resistant bodies, kinematic pairs, degrees of freedom, and classifications of kinematic pairs.
- To familiarize students with the analysis of instantaneous centers and the angular velocity of mechanisms using the I-center method.
- To provide an understanding of dynamic force analysis in mechanisms, including D'Alembert's Principle, equivalent offset inertia force, and the analysis of slider-crank mechanisms.
- To introduce the basics of machine design, including the design procedure, use of standards, manufacturing considerations, and the significance of preferred numbers.
- To familiarize students with the mechanical properties of materials and their significance in machine design.
- To provide knowledge of design for static strength, including simple stresses, combined stresses, torsional and bending stresses, stress-strain relationships, theories of failure, and factors of safety.

## COURSE OUTCOMES:

CO1: Apply the principles of mechanisms and kinematic pairs to analyze and design mechanisms with specific degrees of freedom.

CO2: Analyze and evaluate the dynamics of mechanisms using dynamic force analysis techniques, including D'Alembert's Principle and the analysis of slider-crank mechanisms.

CO3: Apply the principles and techniques of machine design, including the use of standards, manufacturing considerations, and preferred numbers.

CO4: Understand the mechanical properties of materials and their significance in machine design.

CO5: Apply the principles of design for static strength, including stress analysis, theories of failure, and factors of safety.

## UNIT I

**Introduction:** Mechanisms and machines, Rigid and resistant bodies, Link, Kinematic pair, Degrees of Freedom, Classifications of Kinematic pairs, kinematic-chain, Linkage, Mechanism, and structure, Classification of mechanisms, Equivalent Mechanisms, Four - Link (bar) Mechanism, Inversions of Slider - Crank Chain, Double – Slider Chain.(6)

**Instantaneous centre**: Notation, Number of I - Centres, Kennedy's theorem, Locating I - Centres, Angular velocity by I - Centre Method. (6)

**UNIT II**

**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. Turning Moment diagrams, Fluctuation of energy and Flywheels

**UNIT III**

**Basics:** Basic procedure of machine design, requirements and design of machine elements, traditional design methods. Design synthesis, use of standards in design, manufacturing considerations in machine design, preferred numbers and significance. (6)

**Materials & their Properties:** Mechanical properties of materials, Common engineering materials and their properties. (4)

**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. (5)

**UNIT IV**

**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, endurance – approximate estimation, reversed stresses – design for finite and infinite life, cumulative damage in fatigue, Soderberg and Goodman lines, modified Goodman diagrams, Gerber equation, fatigue design under combined stresses, impact stresses. (9)

**UNIT V**

**Belt Drives:** Flat and V-belts, Belt constructions, Geometrical relationships, Analysis of belt tensions, condition for maximum power, Selection of V-belts – Selection of Pulleys. (11)

**CHAIN DRIVES:** Introduction, Chain drives, Advantages of chain drives over belt drives, Polygonal effect, Selection of roller chains.

## TEXT BOOKS:

1) Design of machine elements by Bhandari, Tata McGraw Hill book Co.
2) Machine Design by P.C. Sharma & D.K. Agarwal.
3) Design of Machine Elements by Sharma & Purohit, PHI
4) Theory of Machines by S.S. Rattan

## HAND BOOKS TO BE ALLOWED IN UNIVERSITY EXAMINATION:

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

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 1 | 3 | 2 | | | | | | | | | 1 | 2 | 3 |
| CO2 | 2 | 2 | 3 | 1 | | | | | | | | | 3 | 3 | 2 |
| CO3 | 3 | 1 | 3 | 3 | | | | | | | | | 1 | 1 | 2 |
| CO4 | 2 | 2 | 3 | 3 | | | | | | | | | 1 | 2 | 2 |
| CO5 | 3 | 1 | 1 | 1 | | | | | | | | | 1 | 3 | 1 |

# MEM15 (R20): PRODUCTION PLANNING & CONTROL

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To understand the different types of production systems and the internal organization of production planning and control.
- To estimate forecasts in the manufacturing and service sectors using selected quantitative and qualitative techniques.
- To understands the importance and function of inventory and to be able to apply for its control and Management.
- To apply routing procedures and differentiate schedule and loading and interpret scheduling policies and aggregate planning.
- To understand dispatching procedure and applications of computers in production planning and Control.

## COURSE OUTCOMES:

After successful completion of the course, the students are able to

- ★ Ability to understanding of production planning and control.
- ★ Ability to develop production plans.
- ★ Ability to manage inventory.
- ★ Ability to use production management software.
- ★ Ability to create value stream mapping, waste reduction, and continuous improvement.

UNIT I

INTRODUCTION: Definition – Objectives of production Planning and Control – Functions of production planning and control – Elements of production control – Organization of production planning and control department Production systems: Continuous and intermittent production. Mass and flow production, batch production, job order production, production functions (12)

UNIT II

Project Planning through networks: Arrow (Network) diagram representation, rules for constructing an arrow diagram, PERT, CPM, Critical path calculations, Determination of critical path, Determination of floats, Probability considerations in project.(12)

UNIT III

Introduction to Crashing Materials Management, inventory control and MRP: Functions of materials management, inventory control, Inventory control techniques - ABC, VED and FSN analysis. Materials requirement planning (MRP): Importance of MRP, MRP system inputs and outputs, bill of materials, MRP logic. (12)

UNIT IV

Aggregate planning: Long range, intermediate range and short range plans, the aggregate planning problem, aggregate planning methods, mathematical planning models, theoretical planning models (LDR) and heuristic and computer search models, problems. Master Production Schedule; Master Schedule formation – inputs and outputs Routing: Routing procedure – Route sheets– Factors affecting routing. (12)

UNIT V

Scheduling –definition –Difference with loading, Scheduling and loading guidelines, Standard scheduling methods – forward scheduling and backward scheduling, Johnson‘s rules. Dispatching – activities of dispatcher – dispatching procedure – follow up –definition – for existence of functions – types of follow up, applications of computer in production planning and control. (12)

## TEXT BOOK(s):

1) Elements of Production, Planning and Control by Samuel Eilon.
2) Operations management by Joseph G.Monks, Tata McGraw-Hill Inc,

## REFERENCE BOOK(s):

1) Production and Operations management by R.Pannerselvam, PHI, 2nd edition, 2006.
2) Production and Operations Management by S.N.Chary, TMH(4th edition).
3) Production Planning and Control, Mukhopadyay, PH

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | 2 | 2 | 1 | 1 | 1 | | | 2 | | 1 | 1 | 2 | 1 | 2 |
| CO2 | 2 | 2 | 2 | 2 | 1 | 1 | | | 2 | | 1 | 2 | 2 | 1 | 2 |
| CO3 | 2 | 1 | 1 | 2 | 1 | 1 | | | 1 | | 1 | 2 | 1 | 1 | 2 |
| CO4 | 2 | 2 | 2 | 2 | 1 | 1 | | | 1 | | 1 | 1 | 1 | 1 | 1 |
| CO5 | 2 | 2 | 2 | 2 | 1 | 1 | | | 1 | | 1 | 2 | 1 | 1 | 1 |

# MEM16 (R20): METALLURGY AND MATERIAL SCIENCE

| | | | | |
|---|---|---|---|---|
| Lectures / Tutorials | : | **3 Periods / week** | Sessional Marks | **: 30** |
| University Exam. | : | **3 hrs.** | University Exam. Marks | **: 70** |

## COURSE OBJECTIVES:

- To understand the concept of crystal structures and deformations.
- To know the importance of single phase diagrams, binary and ternary phase diagrams.
- Knowledge about the applications of Ferrous, Non Ferrous metals alloys and Nano materials.
- Learning about the importance of various heat treatment processes.

## COURSE OUTCOMES:

- ★ Students will be able to understand and analyze the structure and properties of materials, composites includes MMC, Ceramics.
- ★ Students will be able to apply the principles of Heat treatment processing.
- ★ Students will be able to analyse the principles of metallurgy to understand the behaviour of various materials
- ★ Learning about the latest developments in materials science and metallurgy, including the use of nano materials, biomaterials.
- ★ Understanding the principles of metallurgy, including the processing of metals.

**UNIT I**

Crystallography: Classification of crystals – Bravi's lattices – Miller Indices – Packing factor in cubic systems – coordination number – crystal imperfections – crystal deformation – Slip and Twinning. (6)

Phase Diagrams: Binary phase diagrams – Phase rule – one component system, two component system, isomorphous, eutectic, eutectoid, peritectic and peritectoid systems, concept of Ternary diagrams. (6)

**UNIT II**

Heat Treatment of Steels: Iron–Iron carbide equilibrium diagram, TTT diagrams for eutectoid, hypo and hyper eutectoid steels, martensite and bainitic transformation. (6)

Heat Treatment: Annealing, normalizing, hardening, tempering, surface hardening, age hardening, austempering, martempering and hardenability concept and experimental determination. (6)

**UNIT III**

Strengthening Mechanisms: Strain hardening, solid solution strengthening, grain refinement, dispersion strengthening. (6)

Composite Materials: Properties and applications of Particulate-reinforced composites, fibre reinforced composites, Laminar composites and metal matrix composites. (6)

**UNIT – IV**

Powder Metallurgy: Powder metallurgy process, preparation of powders, characteristics of metal powders, mixing, compacting, sintering, Applications of Powder Metallurgy. Forming and shaping of plastics – Extrusion and Injection moulding. (12)

**UNIT – V**

Ferrous And Non Ferrous Materials: Composition, properties and application of ferrous and non ferrous metals and their alloys. Brief study of cast iron, steels, copper, aluminum, Nano materials – Introduction and Applications (12)

## TEXT BOOKS:

1) Introduction to Physical Metallurgy - Avner, McGrawHill
2) Material Science and Metallurgy - V. Raghavan, Pearson Education / PHI.
3) Material Science and Metallurgy - R.B.Choudary - Khanna Pub.

## REFERENCE BOOKS:

1) Material Science and Metallurgy - Dr.V.D.Kodgire, Everest Publishers
2) Nano materials – J.Dutta & H.Hofman
3) Manufacturing Engineering & Technology – Kalpak Jain & Schmid, Pearson / PHI

## CO-PO/PSO MAPPING MATRIX:

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 2 | 2 | 3 | 1 | - | - | - | 2 | 1 | 3 | 2 | 3 |
| CO2 | 3 | 2 | 3 | 1 | 3 | 3 | - | - | 2 | - | 2 | 2 | 3 | 3 | 3 |
| CO3 | 3 | 1 | 2 | 1 | 2 | 2 | - | - | - | - | 1 | 3 | 2 | 2 | 2 |
| CO4 | 3 | 3 | 3 | 3 | 3 | 3 | 1 | - | 2 | - | 2 | 2 | 3 | 2 | 2 |
| CO5 | 3 | 1 | 1 | 1 | 2 | 2 | - | - | - | - | 3 | 3 | 3 | 3 | 1 |

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