# MVSR ENGINEERING COLLEGE

(An Autonomous Institution)

## MASTER OF ENGINEERING

## ACADEMIC REGULATIONS , SCHEME OF INSTRUCTION & SYLLABI (R-25)


## MECHANICAL ENGINEERING

(I, II, III & IV Semesters)

## ACADEMIC YEAR 2025-26

(Sponsored by Matrusri Education Society, Estd.1980

ISO 9001:2015

nirf 2020 Rank band 251-300

ACCREDITED BY NAAC NATIONAL ASSESSMENT AND ACCREDITATION COUNCIL

NBA Accredited Courses Civil,CSE,ECE, EEE,Mech & IT

R-25

# Rules and Regulations for M.E. /M.Tech Programs

# MVSR Engineering College

**Nadergul, Hyderabad – 501510**

**(An Autonomous Institution)**

**Accredited by NAAC & NBA Program**

**2025**

# College Profile

MVSR Engineering College is established in 1981 and affiliated to Osmania University. Currently, the college has B.E programs in Civil, CSE, ECE, EEE, IT, Mechanical and Automobile Engineering, PG programs in Civil Engineering, CSE, ECE and Mechanical besides MBA. College is recognized by Osmania University as a Centre for pursuing research leading to the award of Ph.D. Degree in the Disciplines of CSE, ECE and Mechanical Engineering. In all about a 1000 students take admission every year. The college is one of the earliest of the private Engineering colleges in the state. Since inception, the college has ensured an excellent and exemplary academic standard which has helped the college to be one of the topmost and most sought after college in the state.

**Vision:**

- To Impart technical education of the highest standards, producing technically competent confident and socially responsible engineers.

**Mission:**

- To impart adequate fundamental knowledge, technical and soft skills to students.
- To make learning process exciting, stimulating and joyful.
- To create a climate conducive to excellent teaching - learning Process.
- To bring out creativity in students.
- To contribute to advancement of engineering & technology.
- To make positive contribution to meet societal needs.

# MVSR Engineering College

**Hyderabad**

# Quality Policy

To provide quality education in engineering through continual upgradation of

Teaching - learning process,

Human resources and

Infrastructure

so as to produce competent and committed professionals.

**Date: 01.06.2010**

**Place: Hyderabad**

**PRINCIPAL**

# Rules and Regulations

## M.E. /M.Tech. Programs (Full-Time)

***(Applicable to the students admitted from the Academic Year 2025-2026 onwards)***

### 1. INTRODUCTION:

**1.1** Provision of these rules and regulations shall come into force with effect from the academic year 2025-2026 and shall be applicable to all the M.E / M.Tech. courses offered by the Institute

**1.2** All the rules and regulations, herein after specified shall be read as a whole for the purpose of interpretation.

### 2. GENERAL:

**2.1** This document gives the general regulations applicable to all M.E. /M.Tech programs. Specific requirements for a particular M.E / M.Tech program are specified in regulations for that program.

**2.2** Any condition arising in the PG program and not covered in this manual shall be referred to the PG committee, which may refer it to the academic committee / Council of the institute.

### 3. M.E /M.TECH PROGRAMS:

The M.E. / M.Tech programs are offered in the following specializations by the respective departments of the Institute.

| Department | Program | Course/ Specialization (s) | Minimum eligibility criteria |
|---|---|---|---|
| Civil Engineering | M.E | Structural Engineering | B.E / B.Tech in Civil Engineering |
| Computer Science and Engineering | M.Tech | Computer Science and Engineering | B.E./B.Tech in CSE / IT and Allied Branches |
| Electronics and Communication Engineering | M.E | Embedded systems and VLSI Design | B.E/ B.Tech in Electronics and Communication Engineering |
| Mechanical Engineering | M.E. | CAD/ CAM | B.E. / B.Tech in Mechanical Engineering |

### 3.1 ELIGIBILITY FOR ADMISSION*

An applicant for admission into the M.E. / M.Tech. Program shall have one of the following qualifications:

**3.1.1** A Bachelor's degree in Engineering/Technology as mentioned against each specialization in the table 1 above, which is equivalent to the Bachelor's degree in Engineering / Technology of Osmania University.

**3.1.2** AMIE Degree or similar qualification recognized by the UPSC as equivalent to B.E / B.Tech.

**3.1.3** The candidates will be admitted strictly in accordance with the merit secured at the Entrance Examination conducted by the Government of Telangana, keeping in view of the rules in force regarding the reservations of seats to various categories of candidates.

*** Subject to review from time to time as per the directives of competent authority.**

## 3.2 HOW TO APPLY

A candidate seeking admission into the M.E./M.Tech. Program shall apply in the prescribed form as per the notification issued by Convener, PGECET (on behalf of TSCHE) every academic year.

## 3.3 ADMISSION

a) Admissions to Category 'A' will be filled by the Convener, PGECET appointed by TSCHE after conducting the counseling for admission to PG programs.
b) Admissions to category 'B' will be filled by the institute as per the norms from time to time.

**The following documents are to be submitted at the time of admission**

1. X and XII Std. Marks statement
2. Mark Sheets of all semesters/ years wise / consolidated of the qualifying degree examination, up to pre-final/ final year as applicable if result awaited.
3. Qualifying Degree / Provisional Certificate (If degree completed)
4. Transfer/Migration/College Leaving Certificate obtained from the Institute last studied (If already received)
5. Valid GATE Score Card (If available)
6. Community Certificate (only for SC/ST categories).
7. Nativity Certificate (for Jammu & Kashmir, Ladakh and North Eastern States)

## 4. COURSE STRUCTURE

**4.1** The duration of M.E. / M.Tech. (Full – Time) Programme is 4 semesters. The total period of study for the purpose of drawing the scholarship amount (if eligible) shall not exceed 24 months. Each semester shall have 16 weeks of instruction.

**4.2** The total course for an M.E. / M.Tech degree program will typically consist of the following components:

| | |
|---|---|
| a. | Program Core Courses |
| b. | Program Elective courses |
| c. | Mandatory courses |
| d. | Audit courses |
| e. | Open Electives |
| f. | Mini project |
| g. | Laboratory |
| h. | Internship |
| i. | Major Project |

**M.E./M.Tech. Four Semester Program Scheme of Instruction and Evaluation**

| S.No. | Course Name | Contact hours per week | | | Scheme of Examination | | Credits |
|---|---|---|---|---|---|---|---|
| | | L | T | P | CIE | SEE | |
| | **SEMESTER-I** | | | | | | |
| 1. | Core-I | 3 | | | 30 | 70 | 3 |
| 2. | Core-II | 3 | | | 30 | 70 | 3 |
| 3. | Programme Elective-I | 3 | | | 30 | 70 | 3 |
| 4. | Programme Elective-II | 3 | | | 30 | 70 | 3 |
| 5. | Research Methodology and IPR | 3 | | | 30 | 70 | 3 |
| 6. | Audit Course-I | 2 | 1 | | 30 | 70 | 0 |
| 7. | Laboratory-I | 0 | | 3 | 50 | - | 1.5 |
| 8. | Laboratory-II/Seminar-I | 0 | | 3 | 50 | - | 1.5 |
| | TOTAL | **17** | **1** | **6** | **280** | **420** | **18** |
| | **SEMESTER-II** | | | | | | |
| 1. | Core-III | 3 | | | 30 | 70 | 3 |
| 2. | Core-IV | 3 | | | 30 | 70 | 3 |
| 3. | Programme Elective-III | 3 | | | 30 | 70 | 3 |
| 4. | Programme Elective-IV | 3 | | | 30 | 70 | 3 |
| 5. | Audit Course-II | 2 | 1 | | 30 | 70 | 0 |
| 6. | Mini Project with seminar | | | 6 | 50 | | 3 |
| 7. | Laboratory-III | | | 3 | 50 | - | 1.5 |
| 8. | Laboratory-IV/Seminar-II | | | 3 | 50 | - | 1.5 |
| | TOTAL | **14** | **1** | **12** | **300** | **350** | **18** |
| | **SEMESTER-III** | | | | | | |
| 1. | Programme Elective-V | 3 | | | 30 | 70 | 3 |
| 2. | Open Elective | 3 | | | 30 | 70 | 3 |
| 3. | Major Project-I | | | 20 | 100 | | 10 |
| | TOTAL | **6** | | **20** | **160** | **140** | **16** |
| | **SEMESTER-IV** | | | | | | |
| 1. | Major Project-II | | | 32 | | 200 | 16 |
| | **GRAND TOTAL** | | | | | | **68** |

CIE: Continuous Internal Evaluation SEE: Semester End Examination

| **Audit Courses – I& II** | **Open Electives** |
|---|---|
| 1.English for Research Paper Writing | 1.Business Analysis |
| 2.Disaster Management | 2.Industrial Safety |
| 3.Sanskrit for Technical Knowledge | 3. Operation Research |
| 4.Value Education | 4.Cost Management of Engineering Projects |
| 5.Constitution of India | 5. Composite Materials |
| 6.Pedagogy Studies | 6. Waste to Energy |
| 7.Stress Management by Yoga | |
| 8.Personality Development through Life Enlightenment Skills | |

## 5. PROGRAM FEE AND SCHOLARSHIP

**5.1** Course fee will be informed at the time of admission. Each student shall pay the course fee and other fees as specified at the beginning of the academic year.

**5.2** Eligible students joining with GATE rank will be given scholarship as per the norms. (See appendix III)

## 6. PROGRAM REQUIREMENTS

**6.1** The degree of M.E./M.Tech. will be conferred on a candidate who has (a) pursued a regular course of study of not less than three semesters of course work as prescribed hereunder and has passed all examinations in the subjects as prescribed in the Scheme of Examination, and (b) submitted and successfully defended his/her Major Project at the end of the fourth semesters (Regular programme) as prescribed in the Scheme of Instruction and Evaluation.

**6.2** A regular course of study for eligibility to appear in any subject, for which an examination will be conducted at the end of the semester shall mean putting in an attendance of not less than 75% in each of the subject registered during that semester.

**6.3** However, in special cases and for sufficient causes shown, the competent authority may condone the deficiency of not exceeding 10% attendance for ill-health when an application is made for such a condonation supported by a medical certificate issued by an authorized medical officer and approved by the Institute. Absence not exceeding two weeks, for activities like N.S.S., Inter University Competitions and debates will be condoned if the candidate is sponsored by the institute for such activities.

**6.4** If a candidate fails to secure the minimum of 65% attendance required in any subject, then he/she shall not be eligible to appear for the Semester End Examination at the end of the semester in the subject. He/she shall be required to pursue a regular course of study in the subject again before appearing for the Semester End Examination (SEE) in that subject.

**6.5** If a candidate fails to maintain a minimum of 40% attendance in at least three of the Theory subjects registered independently (excluding Seminar and Laboratory courses) in the first semester following the admission, he/she shall forfeit his/her seat in the course and the admission automatically stands cancelled.

**6.6** The course requirements will be as per AICTE Model Curriculum for PG courses in Engineering / Technology, January2018.

**6.7** A student, on being admitted to the M.E / M.Tech. Programme will be assigned to a faculty Adviser / PG Coordinator. With the approval of the Faculty Adviser / PG Coordinator, the students shall draw up a study plan to satisfy all the requirements, keeping in view the area of specialization and then register for the courses.

**6.8** A student shall not be allowed to register for more than two subjects along with the Major Project-II.

**6.9** The registration process should be completed within one week from the date of admission for the I-semester and within one week from the date of commencement of classes for subsequent semesters. For the benefit of those who are unsuccessful in the main examination or for those who wish to reappear in a subject(s), a make – up examination will be conducted. A candidate must register for the main examination at the end of the semester. Failure to register for the main examination makes the candidate ineligible to register for the make-up examination.

**6.10** In the event, the make-up examination results are not declared before commencement of new semester, the candidates may be provisionally permitted to register for the subject(s) / Major Project-I and continuation depends on the declared result.

**6.11** A student is permitted for registration to Semester-III courses, if there are not more than three subjects as backlog from the previous semesters (Backlog for this purpose shall mean Theory courses/ Lab courses / Seminar). Moreover, the student is permitted for registration to Major Project-I, if he/she has completed the requirements of Mini Project. However, if this criteria is not satisfied in case of any student, he/she will be permitted for registration to Major Project-I in the subsequent even semester and for Major Project-II in the next odd Semester. A student without any backlogs will only be permitted to submit the Major Project. Major Project can be carried out at any recognized Institution/ R&D Organization with the approval of the Head of the Department and Head of the Organization.

**6.12** In the first fortnight of the third semester of Full-Time Programme a student shall seek a faculty member of the college who will be willing to be his/her supervisor for the Major Project and register for it, failing which, the Head of the Department shall assign Supervisor. The student may, in addition, can also have an External Supervisor from the organization to which he / she is attached as a Co-supervisor with the approval of Head of the Department concerned.

**6.13** A student shall submit five copies of the Major Project prepared in the standard prescribed format and approved by his / her supervisor on or before the date indicated in the almanac. The format specifications are given in Appendix. Detailed Guidelines on documentation of Major Project work will be issued separately.

**6.14** For such of those candidates who have not completed the course to an extent of maximum of 2 subjects and/or the Major Project within the stipulated period, an additional period of one year in continuation may be given to complete the same by the competent authority on application duly recommended by the concerned Head of Department.

**6.15** The maximum duration for completing all the requirements for obtaining the M.E./M.Tech Programme shall be N+2 (Where '**N'** stand for the normal or minimum duration prescribed for completion of the programme), which is four years from the date of admission.

## 7. EXAMINATION

**7.1** All examinations shall be held by the Institute at such place and on such dates as may be notified.

**7.2** Applications for permission to appear in SEE shall be made only through registration process on payment of the prescribed examination fee.

**7.3** When a candidate's application is found in order and he/she is found eligible to appear in the Semester End Examination (SEE), the Examination branch, shall furnish him/her with a Hall Ticket for the Semester End Examination (SEE) and this Hall ticket shall have to be produced by the candidate before he/she is admitted into the examination hall.

**7.4** A candidate is not entitled to claim refund of the whole or part of the examination fee nor for the reservation of the same for a subsequent examination (s) if he / she fails to present himself / herself for the Semester End Examination for any reason.

**7.5** A student shall appear for the Semester End Examination at the end of each semester only in the subjects registered at the beginning of the semester.

**7.6** A candidate will be permitted to apply for revaluation / recounting in any of the subjects appeared by paying the prescribed fee within five working days from the date of declaration of results.

**7.7** A candidate will be permitted to appear for the make-up examination, which shall be conducted within one and half month from the declaration of the results of the main examination, in the subject(s) failed in the main examination. A candidate shall apply for the make-up examination in the specified format by paying the prescribed fee as per the notification issued by the examination branch. Without appearing in main examination, a candidate foregoes his/her chance to appear in make-up examination.

**7.8** A candidate who is unsuccessful at both the main and make-up examination or has not appeared at these Examinations in [subject(s)] shall register for the subject (s) again and pass these core / elective course (s) as the case may be, irrespective of whether the syllabus remained same or revised. Further, the candidate who had undergone a regular course of study and secured a minimum of 75% attendance for eligibility to appear at the Semester End Examination can register for that course and appear for the SEE directly. The Continuous Internal Evaluation (CIE) marks earned earlier can be improved if the candidate wishes by appearing in the CIE. If the subject in which the candidate has failed is an elective, a new elective may be chosen if required. If a core course (subject) has been dropped in the curriculum, then the core course (subject) to be taken in place of the core course in which the candidate has failed will be specified by the Faculty Adviser / Course Coordinator in consultation with the Head of the department.

**7.9** The distribution of Marks/Grades for the Continuous Internal Evaluation (CIE) and the Semester End Examination (SEE) areas detailed in the Scheme of instruction and Evaluation in table 2.

**7.10** The SEE question paper will contain two parts, Part-A and Part-B. Part- A is for 10 Marks consisting 5 questions one from each unit, student should attempt all questions and each question carries 02 Marks. Part-B carries 50

marks with five questions (each Question carries 10 marks) covering all the five units with internal choice. Questions in part-B may have subdivision.

In theory subject, a candidate shall score i) 40% marks in Semester End Exam and ii) 40% of marks in Continuous Internal Evaluation and Semester End Exam (CIE+SEE) together, in a particular Course, to be declared as 'PASS' in that Course.

In Practical course, a candidate shall score i) 50% marks in Semester End Exam and ii) 50% of marks in Continuous Internal Evaluation and Semester End Exam (CIE+SEE) together, in a particular subject, to be declared as 'PASS' in that subject.

**7.11** In CIE, out of **40 marks, 30 marks** are to be awarded on the basis of 2 class tests (taking average of both tests). Performance of both the tests will be taken into account. Remaining 10 marks are to be awarded based on assignments / seminars / quizzes etc.

**7.12** A minimum of 50% of students or 4 (four) number of students (whichever is the least) must have registered to offer a Program Elective or Open Elective.

**7.13** Laboratory Courses and Seminar listed in the **Scheme of Instructions and Evaluation** are Departmental requirements only. However, the candidate has to complete the same by securing Minimum qualifying marks.

**7.14** For Laboratory courses, out of 50 marks, 30 marks are to be awarded by the faculty concerned. The remaining 20 marks are to be awarded based on the performance of the individual student in Viva-Voce / Quiz etc.

**7.15** Each student is allotted a Mentor/Faculty member to complete Mini Project. Seminar has to be presented on completion of the Mini Project. Out of 50 marks, 30 marks are to be awarded by the mentor and 10 marks are to be awarded by each of the two examiners.

**7.16** During Semester III of Regular Programme, student is expected to present Seminar on Major Project topic covering progress of problem of Major Project topic.

**7.17** The evaluation of Major Project-I consists of 100 marks, of which 50 marks are to be awarded by supervisor and 50 marks to be awarded by internal Viva-Voce committee comprising Chairperson/Head of the Department and two Internal Faculty Members or one internal faculty and one external examiner as examiners. Each internal examiner willaward20marks and Chairperson will award 10marks.

**7.18** During Semester IV of regular programme, the candidate will continue his/her Major Project work on the same topic and complete it by the end of semester. The candidate should examine his/her Major Project work checked for plagiarism by the software provided by the institute. The candidate can submit his/her Major Project, when the similarity index is less than 30%.

**7.19** A student who has successfully completed all the programme requirements, is eligible to submit the Major Project.

**7.20** Students who fail to submit their Major Project and complete the examination formalities at the end of fourth semester (as per the almanac notified) need to re-register for their Major Project work in the following

semester (in no case later than the N+2 from the date of admission), where '**N'** stands for the normal or minimum duration prescribed for completion of the programme. They will have to pay the prescribed fee for re-registration of Major Project work every semester till the completion of their Major Project work.

## 8. MAJOR PROJECT WORK AND EVALUATION PROCESS:

Every candidate shall be required to submit thesis or Major Project after selecting a topic approved by the Project Review Committee.

**8.1** Project Review Committee (PRC) shall be constituted by the Principal, Chairman BOS which consists of HOD as chair, PG Coordinator as Supervisor and Senior Faculty members of the Department.

1. Registration of Project work: A candidate is permitted to register for the project work in Third Semester.

2. The candidate has to submit his project proposal in consultation with his projects supervisor, the title, objective and plan of action of his/her project work to the PRC for its approval. Only after obtaining the approval of PRC the student can initiate the Project work.

3. If a candidate wishes to change his supervisor or topic of the project be can do so with approval of PRC. However, the PRC shall examine whether the change of topic/ supervisor leads to a major change of his initial plans of project proposal, If so, his date of registration for the project work start from the date of change of supervisor or topic as the case may be.

4. At the end of the III Semester, the project work progress is to be evaluated for 100 marks by the PRC Committee.

5. A candidate can submit project thesis only after successful completion of all theory and practical courses without any active backlogs and approval of PRC not earlier then 40 weeks from the date of registration of project work. For the approval of PRC the candidate shall submit the draft copy of the thesis to the Head of the Department and shall make an oral presentation before the PRC.

6. Three copies of the Project thesis certified by the supervisor shall be submitted to the concerned Head of the Department.

7. The external examiner for the final Viva-Voce examination shall be selected by the Dean (Examinations) along with Dean (Academics) of MVSREC and for this the Head of the concerned Department shall submit a panel of 5 examiners, who are eminent in that field with the help of the concerned guide.

8. Final Viva-Voce examination shall be conducted by a Board consisting of the External Examiner, Head of the Department, Supervisor and Project Coordinator.

**8.2** The candidate who has passed all the courses and Departmental requirements has to present the Major Project-II to the internal Viva-Voce Committee. The Major Project shall be scrutinized and evaluated by the Viva-Voce committee consisting of the Head of the Department, Internal Examiners and Supervisor of the candidate. The Head of the department is the Chairperson of the Viva-Voce Committee and Department PG coordinator/ project coordinator is the Convener. The Viva-Voce will be conducted as per the Almanac and will normally be twice in an academic year.

**8.3** The Viva-Voce committee will give a comprehensive report indicating the adequacy or otherwise of the Major Project-II, If candidate's Major Project -II work is found inadequate by the Viva-Voce committee, he/she has to appear once again for the Viva – Voce examination. The candidate will have to revise the Major Project-II as per recommendations of the Viva-Voce committee. The Department shall arrange for the conduct of pre-submission Viva-Voce and submit the final copy within two weeks to the Examination branch for conduct of Viva-Voce in consultation with the concerned Head of the department.

**8.4** Within four weeks from the date of submission to the Exam branch, the external Viva-Voce examination shall be conducted. The external Viva-Voce Committee consists of the Head of the Department, External Examiner and Supervisor of the candidate. The evaluation of Major Project-II for maximum of 200 marks will be done as per the guidelines given below.

1) 70 Marks are allocated for quality of Major Project work covering
   I. Literature review
   II. Innovation/Originality
   III. Research Methodology adopted and
   IV. Relevance/Practical applications by supervisor.

2) 70 Marks are provided for Report writing/ Documentation

3) 30 Marks are allocated for quality and clarity of presentation of Major Project work.

4) 30 Marks are provided for candidate's performance in terms of his/her ability to defend the work, his/her ability to answer the queries raised during Viva-Voce examination and overall subject knowledge.

Total = (a+b+c+d= 200 Marks)

**8.5** The formats for pre submission Viva-Voce and final Viva are given in Annexure I & II respectively.

## 9. AWARD OF DEGREE

A candidate shall be deemed to have fully passed in the subjects he/she has registered during the semester, if he/she secures not less than the minimum marks prescribed below:

**Minimum Qualifying Marks**

| Course particulars | Exam | Minimum Marks / Grade |
|---|---|---|
| (i) Each Theory Course | (CIE+SEE) | **40% in SEE** |
| (ii) Each Laboratory Course<br>(iii) Each Seminar<br>(iv) Major Project-I<br>(v) Major Project-II | (CIE)<br>(CIE)<br>(CIE)<br>(SEE) | 50%-'D' Grade |

## 10. GRADING SYSTEM

Grades are awarded based on the combined marks secured in the Semester End Examination (SEE) (Maximum 70%) and Continuous Internal Evaluation (CIE) (Maximum 30%) as per the criteria stated in the following Table:

| Academic Performance | Letter Grade | Grade Points |
|---|---|---|
| 90%= Marks≤100% | A+ | 10 |
| 80% = Marks<90% | A | 9 |
| 70%= Marks<80% | B | 8 |
| 60% = Marks<70% | C | 7 |
| 50%= Marks<60% | D | 6 |
| 0%≤Marks <50% | F | 0 |

i) The Memorandum of marks of a candidate will reflect the grade secured by him / her as per the grading criteria described in the table above.

ii) There is no minimum marks criteria for the Continuous Internal Evaluation (CIE) for theory subject(s).

iii) A minimum Cumulative Grade Point Average (CGPA) of 5 is required for the award of Degree. The consolidated memorandum of marks will reflect the credits / grade scored in each subject.

**Semester Grade Point Average (SGPA) & Cumulative Grade Point Average (CGPA) Calculation:**

(a) A student is said to have earned credits if he / she secures letter grade 'D' and above

(b) $$SGPA = \frac{\sum [\text{Letter Grade Point} * \text{Credits}]}{\sum \text{Credits}}$$

SGPA is calculated up to second decimal point

SGPA is calculated only when all subjects in that semester are Cleared/ Passed

(c) $$CGPA = \frac{\sum [(SGPA) * (\text{Total Credits})]}{\sum (\text{Total Credits})}$$

CGPA at a given point of Semester is calculated up to second decimal point CGPA is calculated only when total credits earned are equal to total credits up to a Semester in which the candidate has last appeared for Semester End Examination

(d) Memorandum of Marks should indicate total number of credits and total number of credits earned up to a point of Semester

**10.1.** In case of hearing impaired, orthopedically handicapped and visually challenged candidates, 10% reduction in pass marks in each subject is admissible as per G.O. Ms.No.150, dated 31-08-2006.

**10.2.** A candidate desiring to have recounting / revaluation can apply for it as per the institute norms and notification of Exam branch.

**10.3.** A candidate can also obtain a photocopy of the corrected answer book of the theory subjects SEE only on payment of Rs.1000/- (Rupees One thousand only) for each subject as per the notification of Exam branch.

**10.4.** In order to qualify for a PG degree of the institute, a student

1. Must have completed all the credit requirements for the degree as prescribed from time to time
2. Must have obtained a CGPA of at least 5.00 at the end of the semester in which the student completes all the requirements (including Major Project) for the degree

## 11. AWARD OF GOLD MEDAL

A student securing highest CGPA in **single attempt** is eligible for award of Gold Medal.

## 12. TRANSITORY REGULATIONS

1. Whenever the schemes of Instruction and /or syllabi are changed for a course, candidates shall satisfy the unfulfilled requirements of passing the number of core subjects and electives choosing equivalent subject/s from the revised schemes, with the approval of the competent authority.

2. Whenever a course or scheme of instruction has changed in a particular semester/year, two more examinations immediately following thereafter shall be conducted according to the old syllabus/regulations provided the content in the course has changed more than 40%.

3. Candidates not appearing at the examinations or failing in them shall register/appear for the examination subsequently according to the changed syllabus / regulations.

**MALPRACTICE AND AWARD OF PUNISHMENT**

**Regulations under Ordinance no. vii**

**Conduct of Examinations Part – V**

**Schedule on the Nature of Malpractice and Award of Punishment**

**"Examination"** in this context refers to all the papers taken by the candidate on the same hall-ticket.

| S.No. | Malpractice | Award of Maximum Punishment |
|---|---|---|
| 1. | Possession of the prohibited (written or printed) papers, books, notes during the examination period but which were not used. | Shall be debarred from appearing at the subsequent papers of the examination apart from cancelling the result of the examination in which he/she had indulged in malpractice. |
| 2. | Matter relevant to the examination being written on any part of the body or on the clothes worn, or in the instruments, wrappings, etc. | -do- |
| 3. | Attempting to take help from any prohibited papers, notes, written or printed matter, writings on the walls, furniture and attempting to take help from or giving help to other regarding answer to any question or questions of the examination paper. | -do- |
| 4. | Taking help from or consulting of prohibited written or printed material; consulting and/or taking help from or helping other examinee during the examination period inside the examination hall or outside it; with or without their consent, or helping other candidate to receive help from anyone else. | -do- |
| 5. | An examinee who attempts to disclose his/her identity to the paper valuer by writing his/her roll number at a place other than the place prescribed for it, or by writing his/her name or any coded message or an examinee who makes an appeal to the paper valuer in the answer book. | Cancelling the result of that paper |
| 6. | Writing such as invocation of God's name in any form. | To be ignored |
| 7. | Writing on the question paper or other papers; the answer to questions, rough work, etc., with no intention of passing it on to another examinee. | To be warned not to do so |

| | | |
|---|---|---|
| 8. | Using abusive and obscene language in the answer book. | Cancellation of the result of that paper |
| 9. | Examinee allowing or destroying prohibited material found in his possession or acting in any other manner with a view to destroy evidence. | Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting his/her admission to or continuation in any course for a period of one year. |
| 10. | Refusing to obey instructions of the Chief Superintendent/Invigilator | Cancelling the result of that paper |
| 11. | Smuggling an answer book /additional answer book/ matter into or out of the examination hall. | Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting his/her admission to or continuation in any course for a period of one year. |
| 12. | Inserting in or removing from the answer book/additional answer book of any sheet. | -do- |
| 13. | Substituting wholly or partly an answer book/additional answer book. | -do- |
| 14. | Impersonation even at a single examination. | To be dealt with as per law |
| 15. | Cases of examinees when conspiring to interchange in Roll Numbers. | Cancellation of the result of all examinations taken or proposed to be taken during that session and prohibiting their admission to any course for a period of one year. |
| 16. | Creation of disturbance or otherwise misbehaving in and around the examination hall during or before the examination. | Cancelling the results of all examinations taken or proposed to be taken during that session and prohibiting admission into or continuation in any course of study for a period of two years. |
| 17. | Guilty of assaulting/abusing intimidating any person connected with the examination work any time before, during or after the examination | Cancelling the result of all examinations taken or proposed to be taken during that session and the next session and prohibiting admission into or continuation in any course for a period of two years. |
| 18. | Punishments for malpractices not defined here would be recommended on the merits of the individual cases by the malpractices committee. | |

**APPENDIX I**
**Format of M.E./M.Tech. Major Project**

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**Department of CSE / MECH / CIVIL / ECE**

**MVSR Engineering College**

## CERTIFICATE

This is to certify that the Major Project work entitled <Title of the Project Work> submitted by < Mr. / Ms. Name of the student (Roll No.) >, a student of Department of < Name of the Department >, < Name of the College > in partial fulfillment of the requirements for the award of the degree of master of <Engineering/Technology> with <Name of the Specialization> as specialization is a record of the bonafide work carried out by < him / her > during the academic year <Academic year >.

Date of submission of thesis

Signature of the Supervisor

Signature of Head of the Dept.

Seal

## DECLARATION

I declare that the work reported in the Major Project entitled < Title of M.E. / M. Tech. Thesis> is a record of the work done by me in the Department of <Name of the Department, Place/Organization>. No part of the thesis is copied from books / journals / internet and wherever referred, the same has been duly acknowledged in the text. The reported data are based on the Major Project work done entirely by me and not copied from any other source.

Signature of the Student


***Plagiarism Certificate***

This is to certify that the thesis entitled '**Title of the Major Project'** submitted by **Name of the candidate**, towards partial fulfillment of the requirements for the award of the **Master of Engineering/Technology** degree in Engineering with specialization in **Specialization Name** was analyzed for Plagiarism. The Similarity Index was found to be ----% which is less than 30% as per the Faculty of Engineering norms.

| **Originality Report** | | | |
|---|---|---|---|
| **17%** | **12%** | **10%** | **8%** |
| **Similar Index** | **Internet Sources** | **Publications** | **Student Papers** |

**(Signature of the Student)** **(Signature of the Supervisor)**

**(Signature of the Principal/Coordinator, Anti-Plagiarism Software)**

**Station: Hyderabad**
**Date:**

**Appendix II**

**Guidelines for preparing M.E./M.Tech. Major Project**

The Thesis must be presented on A-4 paper approximately 11 inches/9 inches or 27.9 cm/ 22cm and duly hard bound.

**I. General:**

1. The title of the thesis should be concise and clearly convey the work presented.
2. Lists of figures, tables, variables, symbols, acronyms etc., should be included, before the start of the first chapter.
3. The abstract should not be more than 500 words.
4. A declaration stating the originality of work / results should be appended.
5. Any work which amounts to plagiarism should be totally avoided.
6. The entire thesis should be free from grammatical and spelling mistakes.
7. The total number of pages of the thesis should not normally exceed 250.
8. Any downloaded matter of tables or equations, if used, should be rewritten, and the source mentioned.
9. The first Chapter should clearly reflect the importance and objectives of the thesis.
10. A brief literature review may be included in the first or second chapter.
11. The organization of the thesis may be mentioned in the first chapter.
12. The pages should be numbered starting from the first page of the first chapter.
13. The pages before the first chapter should be numbered in small Roman numerals.
14. The headings and sub-headings should be properly numbered chapter wise.
15. Extension work may be indicated in the conclusion.
16. Uniform font and size should be followed for the titles of all chapters.
17. Uniform Indent should be followed throughout the text of the thesis.
18. Similarly uniformly should be maintained for all headings and sub headings.
19. Subscripts and superscripts should be adopted properly.

**II. Formatting**

1. The text should be presented at one and a half spacing.
2. The font size of the main text should be uniformly12 points throughout the thesis.
3. Left justification or left and right justification can be used for main text.
4. The left margin should be 30 -40 mm and the right. Top and bottom margins should be 25to 30 mm.
5. The final Major Project copies should be hard bound in PURPLE colour rexin. The cover page should be gold embossed. On the spine of the Major Project the full name of the candidate and the year of submission should be gold embossed.

## III. References

1. The references should be numbered from the first chapter to the last chapter in ascending order and the corresponding number should be shown in square brackets wherever required.
2. The reference should be listed with details after the last chapter.
3. All the references listed should be referred in the main text.
4. The references could be technical papers of Journals, conferences, symposia, workshops and seminars, technical reports, manuals, textbooks and software.
5. The important contents of referred materials should be in the following order: Name (s) of the author (s), Title of the paper, publication title, year of publication, Vol, No., pp.

## IV. Appendices

1. Important programs, derivations, data and any other useful material may be shown in the appendices with proper numbering.
2. The appendices should be numbered in capital Roman numbers or capital letters from the first chapter to the last chapter in ascending order. (e.g. Appendix1 or Appendix A)
3. The appendices should be shown with details after the last chapter.
4. All the appendices should be referred in the main text.

## V. Equations

1. All the equations used in the thesis should be properly numbered chapter wise (eg.Eq,3.1or)
2. The equations shown should be clearly referred and identified as Eq. or eq. followed by equation number.
3. Repetition of equations should be avoided. If needed, it may be referred by its number.
4. Equations should never be mixed up with main text. It should be shown as separate object and ‘Equation Editor’ can be used.

## VI. Tables

1. The tables shown in the thesis should be clearly referred and explained and they should be numbered properly.
2. At the top of the table, it should be identified as table, followed by table number (ex.Table3.1)
3. The caption of the table should be written clearly, precisely and briefly at the same position.
4. A spacing of at least 3 points should be taken for the first line of each cell.
5. Table size should not cross the limits of the set page margins.
6. The font size should be less than or equal to the font size of main text.

## VII. Figures

1. The figures shown in the thesis should be clearly referred and explained. They should be numbered properly chapter wise.
2. At the bottom of the figure, it should be identified as fig. or figures, followed by figure number (ex. Fig3.1 orfigure3.1).
3. The caption of the figure should be written clearly, precisely and briefly at the same position.
4. All the graphs and flowcharts should be identified and presented the same way as figures.
5. All the figures and graphs should be drawn clearly, so that variables, units, markings and details are dissembled.
6. All the drawings, textboxes, images and details related to a particular figure should be grouped together.
7. The font size used should be less than or equal to the font size of main text.
8. The figure size should not exceed the set page margins.

**Appendix III**

**AICTE - Post Graduate (PG) Scholarship**

**1.0 Objectives of the Scheme:**

**1.1. AICTE:** In order to ensure development of technical education in India awards Post Graduate Scholarship of Rs.12,400/- per month to full-time GATE/GPAT qualified students admitted to AICTE approved post graduate programs in AICTE approved Institutions/ University Departments as per AICTE approved intake.

**1.2. Amount of Scholarship**: The Scholarship under the scheme is Rs.12,400/- per month per student.

**1.3. Duration:** a) The Scholarship is tenable for 24 months or for the duration of the course i.e. from the date of commencement of classes till the date of completion of the classes whichever is lower and is not extendable under any circumstances. b) Students of final years of dual degree integrated programmes would also be entitled to PG Scholarship from the 9th semester onwards in case they get a CGPA score of 8 or above (on a scale of 10 ) i.e. only for one year in final year.

**1.4. Eligibility for Scholarship**: Post Graduate Scholarship is entitled only to those students

i. Having a valid GATE/ GPAT score at the time of admission.

ii. Must be admitted as a full-time scholar.

iii. Students of final years of dual degree integrated programmes would also be entitled to PG Scholarship from the 9th semester onwards in case they get a CGPA score of 8 or above (on a scale of 10 ) i.e. only for one year in final year.

iv. Admitted in AICTE approved Institutions / University Departments & AICTE approved programs viz. Master of Engineering, Master of Technology, Master of Architecture and Master of Pharmacy.

v. Number of PG Scholarship is limited to the AICTE approved intake in the programme in that year. However in addition to the approved intake, AICTE will provide PG scholarship to the additional 10% candidates over and above the approved intake of that course from EWS category, if the university/ institute has admitted students from Economically Weaker Sections (EWSs) as per MHRD OM F.No.12-4/2019-U1 dated 17th January 2019.

**1.5 Other Entitlements**: Students are eligible for following leaves:

- Casual leave: 15 days in an academic year
- Medical leave: Maximum of one month (30 days) in an academic year
- Maternity leave : Candidates are eligible for maternity/ Paternity leave as per Govt. of India norms issued from time to time at full rates of scholarship etc. once during the tenure of their award. However maximum duration of scholarship will not be extended in any circumstances.

**Note:** All kinds of leaves should be approved at the level of the University/College/Institute. Prior approval of the University/Institution/College is mandatory for all types of leaves.

**1.6 Terms and Conditions**:

**I.** In case any student/scholar receives any financial assistance from any other organization during the tenure of course, with due permission of the university/institute, the scholar will not be entitled for the scholarship for the duration in which he/ she is availing such financial assistance and it shall be resumed on discontinuance of such external financial assistance. Further the period for which the scholar has received external financial assistance shall be deducted from the maximum duration of the scholarship.

**II.** Foreign students, sponsored candidates and candidates admitted in PG programs through management quota are not eligible for the Scholarship.

**III.** It will be obligatory for every post-graduate student to undertake 8 to 10 hours (per week) of work related to teaching and research activities as assigned to him /her by the Institute. This could include tutorials, laboratory classes, development and maintenance of laboratories, assistance in research and development activities undertaken by faculty members, maintenance and operation of Computers and other central facilities, assistance in library, etc.

**IV.** The Scholarship will be granted to the student on a monthly basis subject to the satisfactory academic performance and adherence to University/Institute norms/rules and regulations as applicable time to time, certified by the Head of the Institute and obligatory work as per point no (iii) above.

**V.** PG Scholarship is not admissible to passed out students taking 2nd time admission on the basis of re-qualifying GATE/GPAT exam who have already availed the scholarship from AICTE or any other centrally funded institution like – IITs, NITs and IIITs etc. vi) The amount of PG Scholarship is subject to change as per the notification issued by Ministry of Human Resource Development (MHRD), New Delhi (now Ministry of Education) from time to time, with the approval of the Executive Committee of the Council.

**VI.** The student shall be required to give an undertaking to the effect that he/she would not leave the course midway. In case any student leaves the course in midway or failed/ drop out in subsequent year, he/she will be required to refund the total PG Scholarship drawn at the time of leaving the course. For those scholars who left the course midway on or after 1st October 2020, the scholarship shall be stopped.

**VII.** The Scholarship may be discontinued at any time for any kind of misconduct by the student, like involving in the act of ragging, misbehavior etc. on the recommendations of the Head of Institution (HOI).

**VIII.** Salary grant or any other grant e.g. Contingencies, Library, Books etc, will not be admissible to the Institute/College/ University implementing this scheme in compliance with the instructions of Govt. of India, Ministry of Human Resource Development, Dept. of Higher Education, Technical Section – I conveyed vide letter No. F. No. 9-2/2007-TS.I dated 22nd July, 2008.

**IX.** The mode and procedure of payment of Scholarship to the students shall be governed by the policy decision of the AICTE as may be notified from time to time on its web-portal or through advertisement in leading English/Hindi newspapers.

**X.** Any belated claim preferred after one year of the completion of the program shall not be entertained.

**XI.** The AICTE may impose any other conditions as deemed necessary from time to time and the decision of the AICTE shall be final and binding upon the recipients i.e. University/Institute/College/Student who are under the ambit of the AICTE for receipt of PG Scholarship.

**XII.** In case any student/scholar avails the break during the scholarship period on medical ground with due permission of the university/institute, the scholarship will be discontinued from the month of such break and shall be resumed on rejoining the program for the remaining period of scholarship.

## Appendix IV

### STUDENTS' CONDUCT AND DISCIPLINARY CODE

It is the responsibility and duty of each and every student of the Institute to become acquainted with "Students Conduct and Disciplinary Code". It is presumed that every student from the date of his/her admission to the Institute has knowledge of this code. All students are required to strictly adhere to this code as a condition of their admission to the Institute and these rules would be binding on and enforceable against them or any one among them.

**Section 1: Responsibilities of the Students: It shall be the responsibility of the students**

i. To behave and conduct themselves in the Institute campus, hostels and premises in a dignified and courteous manner and show due respect to the authorities, employees and elders.

ii. To follow decent and formal dressing manners. Students should avoid clothing depicting illegal drugs, alcohol, profane language, racial, sexual and vulgar captions etc.

iii. To access all educational opportunities and benefits available at the Institute and make good use of them to prosper academically and develop scientific temper.

iv. To respect the laws of the country, human rights and to conduct in a responsible and dignified manner at all times.

v. To report any violation of this Code to the functionaries under this Code.

**Section 2: Behavior of the Students**

1. Groupism of any kind that would distort the harmony is not permitted.

2. Students are expected to spend their free time in the Library. They shall not loiter along the verandas or crowd in front of the offices or the campus roads. Students should refrain from sitting on places such as parapets, stairs, footpaths etc.

3. Possession or consumption of narcotic drugs and other intoxicating substances are strictly prohibited in the campus and hostels.

4. Silence shall be maintained in the premises of the Institute.

5. Students are not permitted to use mobile phones in the class room, library, computer Centre, examination halls, etc.

6. Students shall refrain from all activities considered as ragging which is a criminal offence.

7. Students are prohibited from indulging in anti-institutional, anti-national, antisocial, communal, immoral or political expressions and activities within the campus and hostels.

8. Politically based students' and other organizations or outfits are not allowed in the campus. Students are strictly prohibited from organizing, attending or participating in any activity or agitation sponsored by politically based organizations.

9. Students shall not deface, disfigure, damage or destroy or cause any loss in any manner to all the public, private or Institute properties.

10. Without specific permission of the authorities, students shall not bring outsiders to the Institute or hostels.

11. No one shall bring, distribute or circulate unauthorized notices, pamphlets, leaflets etc., within the campus or hostels.

12. The possession, distribution or exhibition of any item by any means which is per se obscene is prohibited within the campus or on any property owned/ managed by the Institute.

13. No student shall collect money either by request or by coercion from others within the campus or hostels.

14. The Institute being a place of learning and an exclusive academic zone, nobody shall respond to any call for any form of strike, procession or agitation including slogan shouting, dharna, gherao, burning of effigy or indulge in anything which may harm the peaceful atmosphere of the Institution and shall eschew from violence in the campus and hostels and even outside.

15. Possession or usage of weapons, explosives or anything that causes injury/ damage to the life and limb or body of any human being or property is prohibited.

16. Use of motorized vehicles within the Institute premises is strictly prohibited.

17. Students shall only use the waste bins for dispensing waste materials within the campus including classrooms, hostels, offices, canteen and messes.

18. Any conduct which leads to lowering of the esteem of the Institute is prohibited.

19. Any tours / visits by group of students without prior approval from the Institute is strictly not permitted and will be viewed seriously.

**Section 3: Disciplinary Sanctions:**

1. Any student exhibiting prohibited behavior mentioned in this Code shall, depending upon the gravity of the misconduct or depending on its recurrence, be subjected to any of the following disciplinary sanctions.

2. Any student who is persistently insubordinate, who is repeatedly or willfully mischievous, who is guilty of fraud, in the opinion of the competent authority, is likely to have an unwholesome influence on his/ her fellow students, will be removed from the rolls.

**I. Minor Sanctions**

i. Warning or Reprimand: This is the least sanction envisaged in this Code. The student engaged in any prohibited behavior will be issued a warning letter.

ii. Tendering Apology: The student engaged in any prohibited behavior may be asked to tender an apology for his/her act and undertaking that he/she shall not indulge in such or any of the prohibited behavior in future.

**II. Major Sanctions**

i. Debarring from Examinations: A student/group of students may be debarred from writing all/any/some of the examinations, which forms part of the academic program for which he/she/they has/ have joined.

ii. Suspension: A student may be suspended from the Institute for violation of any of the provisions of this Code. The period of suspension and conditions, if any, shall be clearly indicated in the communication addressed to the student. The student shall lose his/her attendance for the suspended period.

iii. Restitution: Restitution implies reimbursement in terms of money and/or services to compensate for personal injury or loss, damage/disfiguration to property of the Institute or any property kept in the premises of the Institute in any manner. The students/group of students may be asked to compensate for the loss that has been caused to any person or property of the Institute or any property kept in the premises of the Institute due to the act of vandalism perpetrated by the students. The students/group of students shall also be liable to put in their service to restore any loss or damage caused to any property and thereby bringing it to its original form if it is possible.

iv. Forfeiture: Caution deposit of any student engaged in any prohibited behavior shall be forfeited.

v. Expulsion: This is the extreme form of disciplinary action and shall be resorted to only in cases where stringent action is warranted. Expulsion is the permanent dismissal of a student from the Institute. Such a student will not be eligible for readmission to any of the courses of this Institute.

**Section 4: Functionaries under the Code**

i) **Heads of the Departments/ Faculty Advisors/Chief Warden/ Wardens of Hostels:** As the persons in charge of the Departments, the respective functionaries of all Teaching Departments shall have the power and duty to take immediate action to curb any prohibitory behavior as envisaged under this code.

As these functionaries cannot single handedly manage all the issues, they can assign part of the work to the teachers and the teachers of all the departments have the responsibility to inform any incident of prohibited behavior to the Heads of the Departments so that any serious issue can be settled before the same goes out of control. The Head of the Departments shall have the power to impose minor sanctions envisaged under section 3(I) of this Code.

They can also recommend imposition of major sanctions as envisaged under Section 3(II) of this Code to the Director. The Head of the Departments/ Faculty Advisors while taking any action as envisaged in the code shall do so in an impartial manner and see to it that the sanction imposed/proposed is commensurate with the gravity of the prohibited behavior. Any lapse on the part of a teacher/ Warden to report any instance of violence and misconduct on the part of the students shall be reported to the Director by the respective Head of the Departments/Chief Warden.

The Wardens of Hostels shall be responsible for maintaining strict discipline and decorum in the hostel. He/she shall specifically see to it that the inmates of the hostel do not involve themselves in violation of any clause under Section 2 of this Code.

ii) **Deans:** Any authority of the Institute with delegated powers shall have the power to visit/inspect any premises, buildings or any property of the Institute when there is a genuine doubt that any act of prohibited behavior is taking place and can take any lawful actions to curb such behavior. The HODs/ Faculty Advisors/Chief Warden/ Wardens of Hostels shall report to the Dean (Students) any instances of prohibited behavior, who in turn shall bring it to the notice of the Director. The Dean (Students) shall forward the recommendations from the HODs/ Chief Warden to impose a major sanction under Section 3(II) of this Code to the Director after noting his observations. The Dean (Students) can also suo moto recommend action against any student/students indulging in prohibited behavior which is brought to his/ her notice.

iii) **Principal:** The Principal shall be the ultimate authority in imposing major sanctions as envisaged under Section 3(II) against the students for acts of prohibited behavior. The Principal can also entertain any appeal from any student/students aggrieved by the action of any authority of the Institute under or subordinate to the Principal and decide the case on merit.

**Section 5**: **Right to Appeal:**

The student/students aggrieved by the action of any authority of the Institute under or subordinate to the Principal can appeal to the Principal.

**Section 6: Assistance from Law Enforcement Agencies:**

The Deans/ HoD shall have the power and duty to call the Police immediately with the concurrence of the Principal when there is a threat of Law and Order situation in the Campus and also when there is a genuine apprehension that any incident of rioting, vandalism or any other act prohibited by law is likely to take place. The Deans/ HoDs/ Chief Warden shall in such a case give a detailed report to the Principal. The Principal/ Deans/ HoDs/ Chief Warden can also arrange for video recording of the entire situation and take requisite actions through police and other concerned. Authorities

**Section 7: Grievance Redressal Committee**

The Institute will also set up "Grievance Redressal Committee" where the students can air their grievances. The Committee shall consist of the Deans/ HoDs/ Chief Warden and also members of the Parent-Teacher Association. Till these committees are constituted, ad-hoc committees shall be formed by the Director.

**Section 8: Undertaking by the Students**

The students joining any academic program of the Institute will have to give an undertaking to the effect that he/she will comply with the provisions envisaged in this Code in letter and spirit and even if it is not given them as well, will be bound by the provisions of this Code.

**Section 9: Opportunity for Hearing**

No order other than the order suspending or warning a student shall be passed without giving an opportunity of hearing to the Student/ Students.

**Section 10: Ultimate Authority**

For all disciplinary matters related to students, the Principal shall be the ultimate authority as provided herein.

**Section 11: Amendments to the Code**

The administrative council of the Institute shall have the power to amend any of the provisions in this Code. The amendments shall be brought to the notice of the students and faculty of the Institute through notice put on the institute website, notice boards of the institute or through emails.

R25

# M.E. (CAD/CAM)

## R25 SCHEME & SYLLABI

## DEPARTMENT OF MECHANICAL ENGINEERING

**MATURI VENKATA SUBBA RAO (MVSR) ENGINEERING COLLEGE**

**UGC AUTONOMOUS**

Nadergul, Hyderabad

Sponsored by Matrusri Education Society, Estd. 1980

Affiliated to Osmania University & Approved by AICTE

Accredited by NBA & NAAC

ISO: 9001:2015 Certified

# SCHEME OF INSTRUCTION & EXAMINATION
## M.E. (Mechanical Engineering) I – Semester
## Specialization in CAD/CAM

| S. No. | Course Type/Code | Course Name | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Courses** | | | | | | | | | | |
| 1 | Core P25PC001ME | Computer Aided Modelling and Design | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 2 | Core P25PC002ME | Computer Integrated Manufacturing | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 3 | Core P25PC003ME | Digital manufacturing | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 4 | Elective | Professional Elective – I | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 5 | Elective | Professional Elective – II | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 6 | MC | Mandatory Course | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| **Practical/ Laboratory Courses** | | | | | | | | | | |
| 8 | Lab-I P25PC801ME | CAD & Additive Manufacturing Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 9 | Lab-II P25PC802ME | CAM and Automation Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| | | **Total** | **18** | **-** | **04** | **22** | **290** | **460** | **-** | **20** |

**PC**: Program Core **PE:** Professional Elective **OE**: Open Elective **AD**: Audit Course
**MC**: Mandatory Course **HS**: Humanities and social science

**L**: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination

**Note:**

1. Each contact hour is a Clock Hour.
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
3. * If the Mandatory Course is offered in I-Semester, the Open Elective course should be offered in II-Semester. If Open Elective course is offered in I-Semester, then the Mandatory Course should be offered in II- semester.
4. ** Open Elective Subject is not offered to the students of Mechanical Engineering Department.

# SCHEME OF INSTRUCTION & EXAMINATION
## M.E. (Mechanical Engineering) II – Semester
## Specialization in CAD/CAM

| S. No. | Course Type/Code | Course Name | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Courses** | | | | | | | | | | |
| 1 | Core P25PC004ME | Additive Manufacturing Processes | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 2 | Core P25PC005ME | Finite Element Techniques | 3 | 1 | - | 4 | 40 | 60 | 3 | 4 |
| 3 | Core P25PC006ME | Experimental Techniques and Data Analysis | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 4 | Elective | Professional Elective – III | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 5 | Elective | Professional Elective – IV | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| 6 | OE | Open Elective | 3 | - | - | 3 | 40 | 60 | 3 | 3 |
| **Practical/ Laboratory Courses** | | | | | | | | | | |
| 7 | Lab-III P25PC803ME | Drones and Robotics Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 8 | Lab-IV P25PC804ME | Computational Lab | - | - | 2 | 2 | 25 | 50 | 3 | 1 |
| 9 | P25PC806ME | Mini Project with Seminar | - | - | 2 | 2 | 50 | - | 3 | 1 |
| | | **Total** | **18** | **01** | **06** | **25** | **390** | **460** | **-** | **22** |

**PC**: Program Core **PE:** Professional Elective **OE**: Open Elective **AD**: Audit Course
**MC**: Mandatory Course **HS**: Humanities and social science

**L**: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination

**Note:**
1. Each contact hour is a Clock Hour.
2. The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
3. Internship to be carried out in summer break (opt)

## SCHEME OF INSTRUCTION & EXAMINATION
## M.E. (Mechanical Engineering) III – Semester
## Specialization in CAD/CAM

| S. No. | Course Type/Code | Course Name | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Courses** | | | | | | | | | | |
| 1 | Audit | Audit Course | 3 | - | - | 3 | 40 | 60 | 3 | 0 |
| 2 | P25PW801ME | Major Project Phase – I | - | - | 20 | 20 | 100 | - | 3 | 10 |
| | | **Total** | **03** | **-** | **20** | **23** | **140** | **60** | - | **10** |

## M.E. (Mechanical Engineering) IV – Semester
## Specialization in CAD/CAM

| S. No. | Course Type/Code | Course Name | Scheme of Instruction | | | | Scheme of Examination | | | Credits |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | L | T | P/D | Contact Hrs/Wk | CIE | SEE | Duration in Hrs | |
| **Theory Courses** | | | | | | | | | | |
| 1 | P25PW802ME | Major Project Phase – II (Dissertation) | - | - | 32 | 32 | - | 200 | 3 | 16 |
| | | **Total** | **-** | **-** | **32** | **32** | **-** | **200** | - | **16** |

| S. No. | Semester | Credits |
|---|---|---|
| 1 | I | 20 |
| 2 | II | 22 |
| 3 | III | 10 |
| 4 | IV | 16 |
| **Total Credits** | | **68** |

**PC**: Program Core **PE:** Professional Elective **OE**: Open Elective **AD**: Audit Course
**MC**: Mandatory Course **HS**: Humanities and social science

**L**: Lecture **T**: Tutorial **P**: Practical **D**: Drawing
**CIE:** Continuous Internal Evaluation **SEE:** Semester End Examination

**Note:**

Each contact hour is a Clock Hour

1. The practical class can be of two and half hour (clock hours) duration as per the requirement of a particular laboratory.
2. Three Periods of contact load will be assigned to each project guide.
3. Open Elective Subject is not offered to the students of Mechanical Engineering Department.

4. The students who are willing to register for MOOCs in the M.E. (ME) III – semester instead of Professional Electives – IV & V, should register for those of the courses, approved by the CBoS, OU and respective college MOOCs Coordinator. Those students are strictly not permitted to appear for either CIE or SEE of Professional Electives – IV & V if they abstain from attending the semester classwork. Further, for students willing to appear for both MOOCS and Professional Electives, they should fulfill the minimum attendance criteria.

**List of subjects for Professional Core**

| S.No. | Course Code | Course Title |
|---|---|---|
| 1 | P25PC001ME | Computer Aided Modelling and Design |
| 2 | P25PC002ME | Computer Integrated Manufacturing |
| 3 | P25PC003ME | Digital Manufacturing |
| 4 | P25PC004ME | Additive Manufacturing |
| 5 | P25PC005ME | Finite Element Techniques |
| 6 | P25PC006ME | Experimental Techniques and Data Analysis |

**List of subjects for Professional Elective I**

| S.No. | Course Code | Course Title |
|---|---|---|
| 1 | P25PE001ME | Design for Manufacturing and Assembly |
| 2 | P25PE002ME | Flexible Manufacturing Systems |
| 3 | P25PE003ME | Optimization Techniques |
| 4 | P25PE004ME | Python Programming |

**List of subjects for Professional Elective II**

| S.No. | Course Code | Course Title |
|---|---|---|
| 1 | P25PE005ME | Quality Engineering in Manufacturing |
| 2 | P25PE006ME | CNC Technologies and Programming |
| 3 | P25PE007ME | Data Analysis using Machine Learning |
| 4 | P25PE008ME | Product Design and Process Planning |

**List of subjects for Professional Elective III**

| S.No. | Course Code | Course Title |
|---|---|---|
| 1 | P25PE009ME | Fracture Mechanics |
| 2 | P25PE010ME | Mechanics of Composite Materials |
| 3 | P25PE011ME | Vibration Analysis and Condition Monitoring |
| 4 | P25PE012ME | Smart Materials and Structures |

**List of subjects for Professional Elective IV**

| S.No. | Course Code | Course Title |
|---|---|---|
| 1 | P25PE013ME | Tribology in Design |
| 2 | P25PE014ME | Augmented Reality/Virtual Reality (AR/VR) |
| 3 | P25PE015ME | Industrial IoT |
| 4 | P25PE016ME | Reverse Engineering |

**Mandatory Course**

| S.No. | Course Code | Course Title |
|---|---|---|
| 1 | P25MC001ME | Research Methodology & IPR |

## List of Open Electives

| S.No. | Course Code | Course Title |
|---|---|---|
| 1 | P25OE001CE | Green Building Technology (Civil) |
| 2 | P25OE002CS | Business Analytics (CSE) |
| 3 | P25OE003EC | Fundamentals of Embedded System Design (ECE) |
| 4 | P25OE004EE | Waste to Energy (EEE) |
| 5 | P25OE005ME** | Industrial Safety (Mechanical) |
| 6 | P25OE006ME** | Operations Research (Mechanical) |
| 7 | P25OE007CS | Fundamentals of Machine Learning (CSE) |
| 8 | P25OE008EC | Real-time Operating System for Embedded Applications (ECE) |

Note:**Open Elective Subject is not offered to the students of Mechanical Engineering Department.

## List of subjects for Audit Course

| S.No. | Course Code | Course Title |
|---|---|---|
| 1 | P25AD001HS | English for Academic and Research Writing |
| 2 | P25AD002CE | Disaster Management |
| 3 | P25AD003HS | Sanskrit for Technical Knowledge |
| 4 | P25AD004HS | Value Education |
| 5 | P25AD005HS | Constitution of India and Fundamental Rights |
| 6 | P25AD006HS | Pedagogy Studies |
| 7 | P25AD007HS | Stress Management by Yoga |
| 8 | P25AD008HS | Personality Development through life Enlightenment Skills |

## List of Laboratory Courses

| S.No. | Lab No. | Course Code | Course Title |
|---|---|---|---|
| 1 | I | P25PC801ME | CAD & Additive Manufacturing Lab |
| 2 | II | P25PC802ME | CAM and Automation Lab |
| 3 | III | P25PC803ME | Drones and Robotics Lab |
| 4 | IV | P25PC804ME | Computational Lab |

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC001ME** | **Computer Aided Modelling and Design** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To study about the design process and concept of geometric transformations
- To study the concepts of wireframe modelling
- To study the concepts related to surface modelling
- To study the concepts of solid modelling
- To study about advanced modelling techniques, data exchange formats and mechanical tolerancing

**Course Outcomes**

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

- Understand the design process and analyse the modelling concepts and its graphics using transformations
- Analyse the utility and application of wire frame modelling
- Understand the concepts of surface modelling
- Apply the concepts of solid modelling techniques in practical software's
- Understand the various advanced modelling concepts and analyse the utility of data exchange formats

**MODULE-I**

**Introduction to CAD:** Criteria for selection of CAD workstations, Shigle Design Process, Design criteria, Geometric modeling, entities, 2D & 3D Primitives. 2D & 3D Geometric Transformations: Translation, Scaling, Rotation, Reflection and Shearing, concatenation.

**MODULE-II**

**Wire frame modeling**: Curves: Curve representation. Analytic curves – lines, Circles, Ellipse, Conics. Synthetic curves – Cubic, Bezier, B-Spline, NURBS.

**MODULE-III**

**Surface Modeling:** Surface entities, Surface Representation. Analytic Surface – Plane Surface, Ruled Surface, Surface of Revolution, Tabulated Cylinder. Synthetic Surface-Cubic, Bezier, B-spline, Coons.

**MODULE-IV**

**Solid Modeling Techniques:** Graph Based Model, Boolean Models, Instances, Cell Decomposition & Spatial – Occupancy Enumeration, Boundary Representation (B-rep) & Constructive Solid Geometry (CSG).

**MODULE - V**

**Advanced Modeling Concepts**: Feature Based Modeling, Assembling Modeling, Behavioral Modeling, Conceptual Design &Top-Down Design.

**Data exchange formats:** IGES, PDES, STL, STEP.

**Dimensioning and tolerances:** Linear, angular, angular dimensions, maximum material condition (MMC), Least material condition (LMC). Geometric tolerances and Surface finish.

***Suggested Readings:***

1. Ibrahim Zeid, CAD/CAM, Theory and Practice, McGraw Hill,2009.
2. Foley, Van Dam, Feiner and Hughes, Computer Graphics Principles and Practice, 2nd Edition – Wesley, 2000.
3. Martenson, E. Micheal, Geometric Modelling, John Wiley & Sons,1995.
4. Hill Jr, F.S., Computer Graphics using open GL, Pearson Education,2003.
5. P.N. Reddy, Taj Reddy and C. Srinivas Rao, Production Drawing Practice, The HI-TECH Publishers,2002.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC002ME** | **Computer Integrated Manufacturing** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To study about types of manufacturing and engineering concepts w.r.t manufacturing
- To study the concepts of CIM database and its management
- To study the various automation production lines
- To study about CIM models
- To study the advancements in the manufacturing systems

**Course Outcomes**

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

- Understand the need for CIM, evolution of CIM, fundamentals of CIM and the Concept of Concurrent Engineering.
- Know the role of database management of CIM and understand various types of CIM technologies.
- Understand the fundamental networking concepts that helps in integrating all the important components of an enterprise and discusses the different types of CIM models developed by various industries.
- Understand the new trends in manufacturing systems.

**MODULE-I**

**Introduction to CIM:** The meaning of Manufacturing, Types of Manufacturing; Basic Concepts of CIM: CIM Definition, Elements of CIM, CIM wheel, concept of technology, Evolution of CIM, Benefits of CIM, Needs of CIM: Hardware and software. Concurrent Engineering: Definition, Sequential Engineering Versus Concurrent Engineering, Benefits of Concurrent Engineering, Characteristics of concurrent Engineering, Framework for integration of Life-cycle phases in CE, Concurrent Engineering Techniques, Integrated Product Development (IPD), Product Life-Cycle Management (PLM), Collaborative Product Development.

**MODULE-II**

**CIM database and database management systems:** Introduction, Manufacturing Data: Types, sources; Database Terminology, Database requirements, Database models, Database Management System, DBMS Architecture, Query Language, Structural Query Language (SQL): Basic structure, Data definition Language (Create, Alter, Drop, Truncate, View), Data Manipulation Language (store, retrieve, update, delete). Illustration of Creating and Manipulating a Manufacturing Database. SQL as a Knowledge Base Query Language. Features of commercial DBMS: Oracle, MySQL, SQL Access, Sybase, DB2. Product Data Management (PDM), Advantages of PDM.

**MODULE-III**

**Automation Production Lines:** Automated Flow lines, Methods of Workpart Transport, Transfer Mechanism, Buffer Storage, Control Functions, Automation for Machining Operations, Design and Fabrication Considerations.

*Analysis of Automated Flow Lines*: General Terminology and Analysis, analysis of Transfer Lines Without Storage, Partial Automation, Automated Flow Lines with Storage Buffers, Computer Simulation of Automated FlowLines.

**MODULE –IV**

**Enterprise-Wide Integration in CIM and CIM Models:** Introduction to Networking, Principles of Networking, Network Terminology, Types of Networks: LAN, MAN, WAN; Selection of Network Technology: Communication medium, Network Topology, Medium access control Methods, Signaling methods; Network Architectures and Protocols: OSI Model, MAP & TOP, TCP/IP, Network Interconnection and Devices, Network Performance. Framework for Enterprise-wide Integration. CIM Models: ESPRIT-CIM OSA Model, NIST-AMRF Model, Siemens Model of CIM, Digital Equipment Corporation Model, IBM Concept of CIM.

**MODULE - V**

**Future Trends in Manufacturing Systems:** Lean Manufacturing: Definition, Principles of Lean Manufacturing, Characteristics of Lean Manufacturing, Value of Product, Continuous Improvement, Focus on Waste, Relationship of Waste to Profit, Four Functions of Lean Production, Performance Measures, The Supply Chain, Benefits of Lean Manufacturing. Introduction to Agile and Web Based Manufacturing systems.

### *Suggested Readings:*

1. P. Radhakrishnan, S. Subramanyam: CAD/CAM/CIM, New Age International, Fifth edition,2023.
2. S. Kant Vajpayee: Principles of Computer Integrated Manufacturing, Prentice-Hall India, First edition,1998.
3. Nanua Singh: Systems Approach to Computer Integrated Design and Manufacturing- John Wiley & Sons Inc; 1st edition,1995.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC003ME** | **Digital Manufacturing** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **CAD/CAM** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- Understand the evolution of industrial revolutions with emphasis on Industry 4.0.
- Explore Cyber-Physical Systems and their integration in smart manufacturing environments.
- Compare and analyze additive and subtractive manufacturing technologies.
- Learn database-driven decision-making through Product Lifecycle and Shop-Floor Management Systems.
- Examine reverse engineering techniques and digital design principles including digital twins.

**Course Outcomes**

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

- Describe the evolution of industrial revolutions and evaluate how Industry 4.0 reshapes manufacturing globally.
- Apply knowledge of Cyber-Physical Systems including sensors, AI, IoT, AR/VR, and understand their role in smart factories.
- Compare additive and subtractive manufacturing techniques and identify suitable applications for each process.
- Utilize PLM and database systems to manage product data and optimize shop-floor operations throughout the manufacturing lifecycle.
- Demonstrate the use of reverse engineering processes and digital twin technologies for design recreation and enhancement

**MODULE-I**

**Introduction to Digital Manufacturing:** Introduction to industrial revolutions, Industry 4.0: Globalization and Emerging Issues, The Fourth Revolution, LEAN Production Systems, Smart and Connected Business Perspective, Smart Factories, digital manufacturing and its Global scenario. Impact on manufacturing careers, Operation Mode of Digital Manufacturing System, , Merits and demerits of digital Manufacturing systems.

**MODULE-II**

**Cyber Physical Systems:** Introduction. Sensing and Actuation. Next Generation Sensors, , Augmented Reality and Virtual Reality, Role of artificial Intelligence and Big Data analytics in manufacturing. Need of cyber security in Industry 4.0, Basics of Industrial IoT and its scope

**MODULE-III**

**Additive Manufacturing for Digital Transformation:** Introduction to additive manufacturing, process chain, Material selection, Manufacturing, Post processing, Additive manufacturing technologies and processes, Vat photo polymerization, Material extrusion, Material jetting, Sheet lamination, Powder bed fusion, Binder jetting, Planning and slicing additive manufacturing software.

**MODULE-IV**

**Product Database Management Systems:** Types, Management information system, Manufacturing data preparation, Shop-floor control, Automatic identification systems (sensors, trackers)

**Product Life Cycle Management**: Introduction, Types of Product Data, Product life cycle management (PLM) systems, integrated information systems in product lifecycle, Features of PLM System, System architecture, Product information models, Functionality of the PLM Systems.

**MODULE-V**

**Reverse Engineering:** Introduction, need of Reverse engineering process and steps involved. Application domain. Reverse engineering hardware and software.3D object scanning, Solid reconstruction from point cloud and tessellated data, downstream applications.

**Digital Design:** Definition, Introduction, data storage and sharing in digital threads, Type of digital twins, tools and components of digital twins.

***Suggested Readings:***

1. Chua C.K., Leong K.F. and Lim C.S., Rapid Prototyping: Principles and Applications, 3rd Edition, World scientific publications, 2014
2. Fundamentals of Digital Manufacturing Science, by Z. Zhou, S. Xie, D. Chen, Springer, 2012
3. Ibrahim Zeid and Siva Subramanian R, "CAD/CAM - Theory and Practice", Tata McGraw Hill Education, 2011.
4. Vinesh Raja and Kiran J Fernandes, "Reverse Engineering- An Industrial Perspective", Springer-Verlag, 2008.
5. Antti Saaksvuori and Anselmi Immonen, "Product Lifecycle Management", Springer, 2004

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC004ME** | **Additive Manufacturing Processes** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To provide comprehensive knowledge of the wide range of additive manufacturing processes, capabilities and materials
- To understand the software tools and techniques used for additive manufacturing.

**Course Outcomes**

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

- Understand the working principles and process parameters of additive manufacturing processes
- Explore different additive manufacturing processes and suggest suitable methods for building a particular component
- Perform suitable post processing operation based on product repair requirement
- Design and develop a working model using additive manufacturing Processes

**MODULE I:**

**Introduction to Additive Manufacturing**: Introduction to layered manufacturing, Importance of Additive Manufacturing Additive Manufacturing in Product Development. Classification of additive manufacturing processes, AM evolution, Distinction between AM & CNC machining, Steps in AM, Advantages of AM and Types of materials for AM.

**Vat Photopolymerization AM Processes**: Stereolithography (SL), Materials, Process Modeling, SL resin curing process, SL scan patterns, Micro-stereolithography, Mask Projection Processes, Two-Photon vat photopolymerization, Process Benefits and Drawbacks, Applications of Vat Photopolymerization, case studies.

**MODULE II:**

**Material Jetting AM Processes**: Evolution of Printing as an Additive Manufacturing Process, Materials, Process Benefits and Drawbacks, Applications of Material Jetting Processes.

**Binder Jetting AM Processes**: Materials, Process Benefits and Drawbacks, Research achievements in printing deposition, Technical challenges in printing, Applications of Binder Jetting Processes.

**Extrusion-Based AM Processes**: Fused Deposition Modelling (FDM), Principles, Materials, Process Modelling, Plotting and path control, Bio-Extrusion, Contour Crafting, Process Benefits and Drawbacks, Applications of Extrusion-Based Processes, case studies.

**MODULE III:**

**Sheet Lamination AM Processes**: Bonding Mechanisms, Materials, Laminated Object Manufacturing (LOM), Ultrasonic Consolidation (UC), Gluing, Thermal bonding, LOM and UC applications, case studies.

**Powder Bed Fusion AM Processes**: Selective laser Sintering (SLS), Materials, Powder fusion mechanism and powder handling, Process Modelling, SLS Metal and ceramic part creation,
Electron Beam melting (EBM), Process Benefits and Drawbacks, Applications of Powder Bed Fusion Processes, case studies.

**MODULE IV:**

**Directed Energy Deposition AM Processes**: Process Description, Material Delivery, Laser Engineered Net Shaping (LENS), Direct Metal Deposition (DMD), Electron Beam Based Metal Deposition, Processing-structure-properties, relationships, Benefits and drawbacks, Applications of Directed Energy Deposition Processes.

**Friction stir additive manufacturing**: process, parameters, advantages, limitations and applications, Additive friction stir deposition process: principle, parameters, applications, functionally graded additive manufacturing components, Case studies.

**Wire Arc Additive Manufacturing**: Process, parameters, applications, advantages and disadvantages, case studies.

**MODULE V:**

**Materials science for AM** - Multifunctional and graded materials in AM, Role of solidification rate, Evolution of non-equilibrium structure, microstructural studies, Structure property relationship, case studies.

**Post Processing of AM Parts**: Support Material Removal, Surface Texture Improvement, Accuracy Improvement, Aesthetic Improvement, Preparation for use as a Pattern, Property Enhancements using Non-thermal and Thermal Techniques, case studies.

**Process Selection**: Introduction, Selection Methods for a Part, Challenges of Selection, Example System for Preliminary Selection, Process Planning and Control.

***Suggested Readings:***

1. Additive Manufacturing: Principles, Technologies and Applications, C.P Paul, A.N Junoop, McGraw Hill, 2021.
2. Additive Manufacturing, Second Edition, Amit Bandyopadhyay Susmita Bose, CRC Press Taylor & amp; Francis Group, 2020.
3. Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, Ian Gibson, David W Rosen, Brent Stucker, Springer, 2015, 2nd Edition.
4. 3D Printing and Additive Manufacturing: Principles & Applications, Chua Chee Kai, Leong Kah Fai, World Scientific, 2015, 4th Edition.
5. Rapid Prototyping: Principles and Applications in Manufacturing, Rafiq Noorani, John Wiley & Sons, 2006.
6. Rapid Prototyping: Laser-based and Other Technologies, Patri K. Venuvinod and Weiyin Ma, Springer, 2004.
7. Rapid Manufacturing: The Technologies and Applications of Rapid Prototyping and Rapid Tooling, D.T. Pham, S.S. Dimov, Springer 2001.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC005ME** | **Finite Element Techniques** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **1** | **-** | **-** | **40** | **60** | **4** |

**Course Objectives**

- To understand the theory and application of the finite element method for analysing structural systems
- To learn Approximation theory for structural problems as the basis for finite element methods
- To learn formulations for a variety of elements in one, two and three dimensions
- To understand modelling and analysis of structures using planar, solid, and plate elements

**Course Outcomes**

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

- Determine the shape functions and stiffness matrices and finite element equations
- Analyse the behavior of the trusses and frames
- Analyse complex structural problems
- Analyse the thermal behavior of different systems
- Determine the dynamic behavior of the systems

**MODULE-I**

**Introduction**: Finite Element Method of solving field problems. Stress and Equilibrium. Boundary conditions. Strain-Displacement relations. Stress-strain relations. One Dimensional Problem: Finite element modelling. Local, natural and global coordinates and shape functions. Potential Energy approach: Assembly of Global stiffness matrix and load vector. Finite element equations, treatment of boundary conditions. Quadratic shape functions.

**MODULE-II**

**Analysis of trusses and frames:** Analysis of plane truss with number of unknowns not exceeding two at each node. Analysis of frames with two translations and a rotational degree of freedom at each node. Analysis of Beams: Element stiffness matrix for two noded, two degrees of freedom per node for beam element.

**MODULE-III**

Finite element modelling of two-dimensional stress analysis problems with constant strain triangles and treatment of boundary conditions. Two dimensional four noded iso-parametric elements and numerical integration. Finite element modelling of Axisymmetric solids subjected of axisymmetric loading with triangular elements. Convergence requirements and geometric isotropy.

**MODULE-IV**

**Steady state heat transfer analysis:** One dimensional analysis of a fin and two-dimensional conduction analysis of thin plate. Time dependent field problems: Application to one dimensional heat flow in a rod.

**Dynamic analysis**: Formulation of finite element modelling of Eigen value problem for a stepped bar and beam. Evaluation of Eigen values and Eigen vectors. Analysis of a uniform shaft subjected to torsion using Finite Element Analysis.

**MODULE - V**

Finite element formulation of three-dimensional problems in stress analysis. Finite Element formulation of an incompressible fluid. Potential flow problems Bending of elastic plates. Introduction to non-linear problems and Finite Element analysis software.

***Suggested Readings:***

1. Tirupathi R Chandraputla and Ashok.D.Belegundu, *Introduction of Finite Element in Engineering,* Prentice Hall of India, 2024.
2. Rao S.S., *The Finite Element Methods in Engineering,* Pergamon Press,2010.
3. Segerland. L.J., *Applied Finite Element Analysis,* Wiley Publication,1984.
4. Reddy J.N., *An Introduction to Finite Element Methods,* McGraw Hill Company,1984

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC006ME** | **Experimental Techniques and Data Analysis** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To understand the working principle of instruments used for cutting forces measurement and temperature measurement.
- To have knowledge of various precision measuring instruments for metallurgical studies.
- To understand the basic concept of experiment design for collection of data
- To learn the data analysis, optimization of experimental methods for better data.

**Course Outcomes**

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

- Determine the cutting forces, displacement and stresses
- Utilize the various techniques for the measurement of temperature
- Analyse the microstructure using various techniques
- Design the experiment and analyse the data
- Determine the optimization of the experiments and its data

**MODULE-I**

Measurement of Cutting Forces: Strain gauge and piezoelectric transducers and their characteristics. Dynamometer construction, Bridge circuits. Instrumentation and calibration. Displacement and strain measurements by photoelasticity. Holography, interferometer, Moir techniques, strain gauge rosettes.

**MODULE-II**

Temperature Measurement: Circuits and instrumentation for different transducers viz, bimetallic, expanding fluid, electrical resistance, thermister, thermocouples, pyrometers. Flow Measurement: Transducers for flow measurements of non-compressible and compressible fluids. Obstruction and drag methods. Vortex shredding flow meters. Ultrasonic, Laser Dopler and Hotwire anemometer. Flow visualization techniques, Shadow graphs, Schlieren photography. Interferometer.

**MODULE-III**

Metallurgical Studies: Optical and electron microscopy, X-Ray diffraction, Bragg's Law and its application for studying crystal structure and residual stresses. Electron spectroscopy, electron microprobe. Surface Measurements: Micro hardness, roughness, accuracy of dimensions and forms. 3 -D co-ordinate measuring machines.

**MODULE-IV**

Experiment design & data analysis: Statistical methods, Randomized block design, Latin and orthogonal squares, factorial design. Replication and randomization. Data Analysis: Deterministic and random data, uncertainty analysis, tests for significance: Chi -square, student's t-test. Regression modelling, direct and interaction effects. ANOVA, F-test. Time Series analysis, Autocorrelation and autoregressive modelling.

**MODULE - V**

Taguchi Methods: Experiment design and planning with Orthogonal arrays and linear graphs. Additive cause effect model. Optimization of response level. Identification of Design and noise factors.

Performance evaluation and Optimization by signal to noise ratios. Concept of loss function and its application.

**Suggested Readings:**

1. Holman, J.P.: Experimental Methods for Engineers, McGraw Hill Int., New York,7th edition,2017.
2. Venkatesh, V.C., and Chandrasekharan, Experimental Methods in Metal Cutting, Prentice Hall of India, Delhi,1987.
3. Davis, O.V.; The Design and Analysis of Industrial Experiments, Longman, London,1967.
4. Box and Jenkins; Time Series analysis, Forecasting and control, Holden Day, San Francisco,4th edition,2008.
5. Dove and Adams, Experimental stress analysis and motion measurement, Prentice Hall of India, Delhi.
6. Tapan P. Bagchi, Taguchi Methods Explained, Prentice Hall of India, Delhi.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE001ME** | **Design for Manufacture and Assembly** | | | | | | **Elective-I** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To study about the general design principles for manufacturability
- To study process of metallic components design
- To study process of providing various shapes in metallic components design
- To study process of non-metallic components design
- To study process related to assembly of components

**Course Outcomes**

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

- Determine the economic use of the raw materials
- Understand the various secondary manufacturing aspects
- Understand the underlying principles in creating various shapes in metallic components
- Determine the principles involved in non-metallic components design
- Analyse the economical assemblage process with the aid of computers

**MODULE-I**

Introduction: General design principles for manufacturability, strength and mechanical factors, mechanisms selection, evaluation method, geometrical tolerances, tolerance control and utilization. Economic Use of Raw Materials: Ferrous steel, hot rolled steel, cold finished steel, stainless steel, non-ferrous materials aluminium, copper, brass, non-metallic materials, plastics, rubber and composites.

**MODULE-II**

Metallic Components Design: Metal extrusion, metal stamping, fine blanking, four slide parts, spring and wire forms, spun metal parts, cold headed parts, extruded parts, tube and section bends, rolled formed parts, power metal parts, forging electro forming parts, specialized forming methods, turned parts, machined round holes, drilled parts, milled parts.

**MODULE-III**

Metallic Components Design: Planned shaped and slotted parts, screw threaded contoured and internal ground parts, center less ground, electrical discharged, rolled furnished parts, electro chemical and advanced machine parts. Sand cast, die cast, investment cast and other cast products.

**MODULE-IV**

Non-Metallic Components Design: Thermosetting plastic, injection moulded and rotational moulded parts, blow moulded, welded plastic articles, ceramics. Assembled Parts Design: Welded parts, arc, resistance, brazed and soldered parts, gear box assembly, bearing assembly.

**MODULE - V**

Assembled Parts Design: Retension, bolted connection, screwed connections, flanged connections, centred connections, press fitted connections, surface finishing, plated parts, heat treated parts, NC machining, group technology, low-cost automation, computer aided manufacture, product design requirements.

**Case Studies:** Identification of economical design and redesign for manufacture.

***Suggested Readings:***

1. James G.Bralla,―Handbook of product design for manufacturing, McGrawHillCo.,1986
2. K.G.Swift―Knowledge based design for Manufacture‖, Koganpage Limited, 1987.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE002ME** | **Flexible Manufacturing Systems** | | | | | | **Elective-I** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Supply Chain Management | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- Understand the evolution, layout configurations, and essential functions of Flexible Manufacturing Systems.
- Explore the design and operation of manufacturing cells, including standalone and integrated systems.
- Appreciate the role of quality control, team dynamics, and Just-In-Time (JIT) manufacturing in FMS.
- Examine the software infrastructure and database systems supporting FMS design and operation.
- Gain insights into FMS planning, CAD/CAM integration, hardware selection, PLCs, communication networks, and implementation strategies.

**Course Outcomes**

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

- Analyze FMS Layouts and Justification, Understand various layout configurations and explain the criteria for selecting and justifying FMS setups.
- Evaluate Manufacturing Cells and Unattended Machining, Classify different types of manufacturing cells and assess the requirements for effective unattended machining operations.
- Apply Quality Control and JIT Principles in FMS, Implement statistical process control and Just-In-Time methodologies to improve production efficiency and system reliability.
- Integrate Software Systems for FMS Operations, Select and utilize appropriate software tools for design, scheduling, monitoring, and control of FMS.
- Plan and Implement FMS Hardware and Communication Networks, Design comprehensive FMS plans incorporating CAD/CAM systems, PLCs, and communication networks, and outline successful implementation strategies.

**MODULE-I**

**Introduction:** Evolution of FMS, Definition, FMA Layout configurations,-Inline layout, loop layout, loader layout, open field layout, robot configured layout, general FMS considerations, functions of FMS, FMS Justification, Cell/FMS Justification Flow chart.

**MODULE-II**

**Manufacturing Cells & Unattended Machining:** Manufacturing cells - Introduction, Classification of manufacturing cells-Stand alone NC machine cell, Spindle NC machine cell, Integrated multi machine cell, FMS Unattended Machining: Introduction, unattended turning center features and requirements, unattended machining center features and requirements, cellular Vs flexible manufacturing.

**MODULE-III**

**Manufacturers Driving Force:** Quality: Definition, characteristics of quality, Quality improvements, Importance of Quality to cells and systems, Quality of team work, Methods for getting and keeping quality under control-statistical process control and taguchi methods. Just In-Time (JIT) Manufacturing, Benefits of JIT, JIT Relation to FMS, Primary JIT principles.

**MODULE-IV**

**Software for FMS:** Introduction, flexibility targets, system concepts-sequential flow system, single station system, random flow system, software for design functions-capacity planning, simulation and knowledge based system, software for extrinsic functions-production scheduling, process planning, tool management, maintenance planning/reporting, software for intrinsic functions-production control, production monitoring, machine/process control, Machine diagnostics. Software Specifications-absolute specifications and functional specifications, FMS database- Database layout and sub systems.

**MODULE-V**

**FMS Planning, Hardware & Implementation:** CAD Considerations for FMS planning, CAM Considerations for FMS planning. Hardware: FMS hardware configurations and considerations, Programmable logic controllers(PLC'S)- components of PLC, advantages of PLC, Cell controllers, Communication networks-star network, ring network and bus network. FMS Implementation: Acceptance testing, Performance goals and expectations, Maintenance concerns and continued support

***Suggested Readings:***

1. Groover, M.P, Automation, Production Systems and Computer Integrated Manufacturing, Prentice Hall, Fifth edition,2021.
2. Hand Book of Flexible Manufacturing Systems, Jha N. K., Academic Press,2012.
3. Flexible Manufacturing Systems, Shivanad H. K., Benal M. M., Koti V., Newage International (P) Limited, New Delhi, 2006
4. Production System beyond Large Scale Production, Taiichi Ohno, Toyota, Productivity Press India Pvt. Ltd.
5. William W Luggen, "Flexible Manufacturing Cells and System" Prentice Hall of Inc New Jersey, 1991.
6. Reza A Maleki "Flexible Manufacturing system" Prentice Hall of Inc New Jersey, 1991.
7. John E Lenz "Flexible Manufacturing" marcel Dekker Inc New York, 1989.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE003ME** | **Optimization Techniques** | | | | | | **Elective-I** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To study about the design types of simulation
- To study about decision theory
- To study about integer programming
- To study about dynamic programming
- To study about classical optimization

**Course Outcomes**

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

- Determine the simulation process required for various applications
- Analyse the decision making under certainty and uncertainty, risk etc.
- Utilize the different methods of integer programming
- Utilize the skills of dynamic programming for different types of problems
- Analyse and apply the optimization techniques

**MODULE-I**

**Simulation:** Introduction, Types of Simulation, Simulation Models, Monte Carlo Simulation, Random Number, Pseudo Random Number, Mid-Square Method of generating Random Numbers, Application & Limitation, Application of Simulation to Inventory Control and Queuing Problem

**MODULE-II**

**Decision Theory:** Introduction, Decision, Decision Making & Decision Theory, Types of Decisions, decision making process, Types of Decision making Environment: **Decision making under certainty** – Expected Monetary Value (EMV), Expected Opportunity Loss (EOL) Criterion & Expected Value of Perfect Information (EVPI) Criterion **Decision making under risk**- Criterion of Pessimism or Manimax, Criterion of Optimism or Maximin, Minimax Regret Criterion, Criterion of Realism & Criterion of Rationality **Decision making under uncertainty** and **Decision tree analysis**: Introduction, Procedure of Constructing Decision Trees & Solution through Decision Tree Analysis.

**MODULE-III**

**Integer Programming:** Introduction, Types of Integer Programming Problems, Gomory's Cutting Plane method. Branch and Bound method for all Integer Programming Problems & Mixed Integer Programming Problems

**MODULE-IV**

**Dynamic Programming:** Introduction- Bellman's principle of Optimality-Application of dynamic Programming-Linear Programming Problem-Capital budgeting problem

**MODULE - V**

**Classical Optimization:** Introduction; Unconstrained problems of maxima and minima, constrained problems of maxima and minima; Constraints in the form of equations – Lagrangian method; Constraints in the form of inequalities -Kuhn-tucker conditions.

***Suggested Readings:***

1. S.S. Rao, Optimization Theory and Applications, NAI Publishers, Hyderabad, Fifth edition, 2023.
2. S.D. Sharma, Operations Research, Kedarnath and Co. Publishers, Meerut, 2004.
3. V. K. Kapoor, Operations Research, S. Chand, New Delhi, 2004.
4. Hamdy A. Taha, Operations Research, Pearson Education, New York, 2001.
5. Bronson-Schaum Series, Operations Research, McGraw Hill, Singapore, 1983.
6. David Goldberg, Genetic Algorithms, S Chand Publications, 2006.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE004ME** | **Python Programming** | | | | | | **Elective-I** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

The objectives of this course is to impart knowledge of

- Understand the basics of algorithms, flowcharts, and problem-solving strategies.
- Learn the core syntax and features of Python for basic programming tasks.
- Apply control statements and string operations to build structured Python programs.
- Use functions and modules to create reusable and organized Python code.
- Explore built-in data structures in Python for effective data manipulation.

**Course Outcomes**

After completing this course, the student will be able to:

- Design simple algorithms and represent them using pseudocode and flowcharts.
- Develop Python programs using variables, expressions, and formatted I/O.
- Implement decision-making and loops in Python with appropriate syntax.
- Create and apply functions, modules, and packages in Python programs.
- Use lists, sets, tuples, and dictionaries for storing and processing data in Python.

**MODULE - I**

Introduction to Algorithms and Flowcharts Need for computer languages, Generation and Classification of computers Basic organization of a computer, Algorithms, building blocks of algorithms (statements, state, control flow, functions), notation(pseudo code, flowchart, programming language), algorithmic problem solving, simple strategies for developing algorithms(iteration, recursion).

**MODULE - II**

Introduction to Python Programming- Python Interpreter-Interactive and script mode-Values and types, variables, operators, expressions, statements, precedence of operators, Multiple assignments, comments, input function, print function, Formatting numbers and strings, implicit/explicit type conversion.

**MODULE - III**

Control Statements in Python- Indentation in Python, Conditional (if), alternative (if-else), chained conditional (if-elif-else). Iteration-while, for, infinite loop, break, continue, pass, else. Strings in Python - String slices, immutability, string methods and operations.

**MODULE - IV**

Functions -Introduction, inbuilt functions, user defined functions, passing parameters -positional arguments, default arguments, keyword arguments, return values, local and global scope, recursion, and lambda functions.

Modules - The from…import statement, Name of Module, Making your own Modules, The dir () function, The Python Module, Modules and Namespaces, Packages in Python, Standard Library modules.

**MODULE - V**

Data Structures in Python - Lists-creating lists, list operations, list methods, mutability list functions, searching andsorting, Sets-creating sets,set operations. Tuples-Tuple assignment, Operations on Tuples, lists and tuples, Tuple as return value- Dictionaries-operations and methods, Nested Dictionaries.

***Suggested Readings:***

1. Reema Thareja, Python programming using problem solving approach , Oxford university press, Second Edition.2023.
2. Mark Summerfield, Programming in Python 3:A Complete Introduction to the Python Language, Addison-Wesley, 2nd edition,2010,
3. Martin C. Brown," PYTHON: The Complete Reference", McGraw-Hill, 2001.
4. E Balagurusamy-Introduction to Computing and Problem Solving Using Python, McGraw Hill.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE005ME** | **Quality Engineering in Manufacturing** | | | | | | **Elective-II** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- The course aims at providing the students with the details of importance of quality engineering in terms of tolerance through various mathematical models in ANOVA and orthogonal arrays.

**Course Outcomes**

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

- Understand the concept of quality engineering in design and production.
- Analyze tolerances of different components in various designs.
- Perform analysis of variance in different levels.
- Perform calculations through orthogonal arrays.
- Understand and implement concepts of brain storming, bench marking and fishbone diagram.

**MODULE-I: Quality Value and Engineering**: An overall quality system, quality engineering in production design, quality engineering in design of production processes. Loss Function and Quality Level: Derivation and use of quadratile loss function, economic consequences of tightening tolerances as a means to improve quality, evaluations and types tolerances. (N-type, S-type and L-type)

**MODULE-II: Tolerance Design and Tolerancing:** Functional limits, tolerance design for N-type. L-type and S-type characteristics, tolerance allocation for multiple components. Parameter and Tolerance Design: Introduction to parameter design, signal to noise ratios, Parameter design strategy, some of the case studies on parameter and tolerance designs.

**MODULE-III**: **Analysis of Variance (ANOVA**): NO-way ANOVA, One-way ANOVA, Two-way ANOVA, Critique of F- test, ANOVA for four level factors, multiple level factors.

**MODULE-IV**: **Orthogonal Arrays**: Typical test strategies, better test strategies, efficient test strategies, steps in designing, conducting and analyzing an experiment. Interpolation of Experimental Results: Interpretation methods, percent contributor, estimating the mean.

**MODULE – V:** ISO-9000 Quality System, BDRE, 6-sigma, Bench marking, Quality circles Brain Storming - Fishbone diagram - problem analysis.

***Suggested Readings:***

1. Taguchi Techniques for Quality Engineering , Philip J Ross , McGraw Hill, Intl. 13th Edition, 2005.
2. Quality Engineering in Production systems I G. Taguchi, A. Elsayed et al / McGraw Hill Intl. Edition, 1989.
3. Taguchi Methods explained: Practical steps to Robust Design / Papan P. BagchiI Prentice Hall md. Pvt. Ltd.,New Delhi.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE006ME** | **CNC Technologies and Programming** | | | | | | **Elective-II** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **CAD/CAM** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- Understand the fundamentals and components of NC/CNC systems**,** including design elements and classifications.
- Explore DNC systems and programming methods**,** with emphasis on APT programming for 2D machining applications.
- Learn adaptive control techniques and CNC tooling technologies**,** including automatic tool changers and fixturing methods.
- Gain hands-on exposure to CAD/CAM software and post-processing tools**,** for advanced NC programming and tool path generation.
- Evaluate process planning and quality control systems**,** focusing on CMM, optical inspection, and computer-aided methodologies.

**Course Outcomes**

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

- Explain the working principles, classification, and physical components of CNC systems including ball screws, spindles, and LM guideways.
- Demonstrate proficiency in DNC concepts and programming using APT language for standard machining processes.
- Apply adaptive control strategies to real-world machining processes and identify suitable CNC tooling systems.
- Generate and optimize NC programs using CAD/CAM software and evaluate the role and structure of post processors.
- Design and analyze process planning approaches and inspection technologies, including CMM and computer-aided testing.

**MODULE-I**

**Introduction to Numerical Control**: Numerical Control: Introduction, Applications of NC/CNC, Benefits of NC/CNC, Limitations of CNC. Classification of NC/CNC systems: Based on type of **Control. Components of CNC System:** Basic components of CNC system, Design considerations, structure, Antifriction LM guideways, spindles, balls screws.

**MODULE-II**

**DNC Systems:** DNC Concepts, Objectives of DNC, Components of DNC, Types of DNC, advantages and disadvantages of DNC.

**CNC Programming: Part programming:** Introduction, Part Program and its elements,

**Methods of Programming:** Manual and Computer Assisted Part programming, APT Language & programming (statements & programming), Examples of APT programming problems (2D machining- Milling & Drilling)

**MODULE-III**

**Adaptive Control:** Adaptive control with optimization, Adaptive control with constraints, Adaptive control of machining processes like turning, Grinding Tooling for CNC Machines: Types of CNC tooling for cutting (brief introduction of preset, qualified, Interchangeable, coolant fed, and modular tooling systems); Tool presetting; Automatic tool changers; Work holding (modular fixturing).

**MODULE-IV**

**Introduction to CAD/CAM Software:** NC programming using CAD/CAM software, Tool path generation using CAD/CAM software, Technology of CAM, Computer assisted part programming

**Post Processors for CNC:** NC Introduction to Post Processors, necessity of a Post Processor, general structure and functions of a Post Processor

**MODULE-V**

Computer Aided Process Planning: Introduction, Manual process planning vs. Computer aided process planning, Basics of variant and generative process planning methods. Computer Aided Inspection and Quality Control: CMM Construction, Limitations of CMM, Computer Aided Testing, Optical Inspection Methods.

***Suggested Readings:***

1. Computer Aided Design Manufacturing, K. Lalit Narayan, K. Mallikarjuna Rao and M. M. M. Sarcar, PHI,2008.
2. Computer Control of Manufacturing Systems, Yoram Koren, McGraw Hill, First edition,2017.
3. Numerical Control Machine Programming and Software Design, C. H. Chang, M. A. Melkanoff, Prentice Hall.
4. Computer Aided Manufacturing, Shanmuga Sundar, T. Selwyn, C. Elanchezhian.
5. Mastering CAD/CAM, Ibrahim Zeid, McGraw Hill
6. Numerical Control Machine Programming and Software Design, C. H. Chang, M. A. Melkanoff, Prentice Hall.
7. Computer Aided Manufacturing, Shanmuga Sundar, T. Selwyn, C. Elanchezhian

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE007ME** | **Data Analysis using Machine Learning** | | | | | | **Elective-II** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To provide foundational knowledge in data analysis and machine learning tailored for mechanical engineering applications.
- To enable students to preprocess, analyze, and interpret engineering datasets.
- To apply machine learning algorithms to solve real-world mechanical problems.
- To introduce tools and platforms for data handling and model development.

**Course Outcomes**

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

- CO1: Understand data analytics concepts and machine learning techniques.
- CO2: Preprocess and visualize mechanical engineering data.
- CO3: Apply appropriate machine learning algorithms to mechanical engineering problems.
- CO4: Evaluate and interpret model performance using engineering datasets.
- CO5: Use ML tools like Python, Scikit-learn, TensorFlow for implementation.

## MODULE-I: Introduction to Data Analysis and ML in Mechanical Engineering

- Basics of data science and machine learning
- Importance in mechanical systems (condition monitoring, predictive maintenance, thermal analysis)
- Types of data: numerical, categorical, time-series, image data
- Overview of tools: Python, Pandas, NumPy, Jupyter Notebook

## MODULE-II: Data Preprocessing and Visualization

- Data cleaning, normalization, outlier detection
- Feature engineering: scaling, encoding
- Data visualization using Matplotlib, Seaborn

## MODULE-III: Supervised Learning Techniques

- Regression (Linear, Polynomial, Ridge, Lasso)
- Classification (Decision Trees, k-NN, SVM, Logistic Regression)
- Model validation: cross-validation, confusion matrix, accuracy, precision

## MODULE-IV: Unsupervised and Advanced ML Techniques

- Clustering: K-means, Hierarchical clustering
- Dimensionality reduction: PCA, LDA
- Introduction to Neural Networks and Deep Learning (overview only)

**MODULE – V: Applications in Mechanical Engineering**

- Predictive Maintenance using time-series analysis
- Quality Control and Process Optimization
- Fault Diagnosis in Mechanical Systems
- Smart Manufacturing and Industry 4.0 concepts

**Case Study:**

i) Vibration data preprocessing for fault diagnosis
ii) Predicting machine failure or material fatigue
iii) ML model development on a real mechanical dataset
iv) Grouping thermal patterns in heat transfer analysis

**Reference Books:**

- Tom Mitchell – Machine Learning
- M. Gopal – Applied Machine Learning, Second Edition
- Christopher M. Bishop – Pattern Recognition and Machine Learning

**Textbooks:**

- Andriy Burkov – The Hundred-Page Machine Learning Book
- Trevor Hastie, Robert Tibshirani – The Elements of Statistical Learning
- Python Data Science Handbook – Jake VanderPlas

**Software/Tools Used:**

- Python (NumPy, Pandas, Scikit-learn, Matplotlib, Seaborn)
- Jupyter Notebook
- TensorFlow/Keras (for basic neural network examples)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE008ME** | **Product Design and Process Planning** | | | | | | **Elective-II** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To learn the essential factors with innovative ideas to develop successive right product.
- To know the product reliability, copyrights, value Engineering in product design and cost estimation of product.
- To understand the various machining processes, improving tolerances methods, selection of materials and their importance.
- To understand the modern approaches, ergonomics considerations in product design, integration of design, manufacturing and production control.

**Course Outcomes**

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

- Understand the functions related to the product design and process design
- Estimate the product reliability
- Determine the manufacturing process based on the application
- Design as per the industrial ergonomics
- Utilize the computers for the management of the manufacturing process

**MODULE-I**

Product design and process design functions, selection of a right product, essential factors of product design, Morphology of design, sources of new ideas for products, evaluation of new product ideas. Product innovation Procedure-Flow chart. Qualifications of product design Engineer. Criteria for success/failure of a product. Value of appearance, colours and Laws of appearance.

**MODULE-II**

Product reliability, Mortality Curve, Reliability systems, Manufacturing reliability and quality control. Patents: Definitions, classes of patents, applying for patents. Trademarks and copyrights. Cost and quality sensitivity of products, Elements of cost of a product, costing methods, cost reduction and cost control activities. Economic analysis, Break even analysis Charts. Value engineering in product design, creativity aspects and techniques. Procedures of value analysis – cost reduction, material and process selection.

**MODULE-III**

Various manufacturing processes, degree of accuracy and finish obtainable, process capability studies. Methods of improving tolerances. Basic product design rules for Casting, Forging, Machining, Sheet metal and Welding. Physical properties of engineering materials and their importance on products. Selection of plastics, rubber and ceramics for product design.

**MODULE-IV**

Industrial ergonomics: Man- machine considerations, ease of maintenance. Ergonomic considerations in product Design-Anthropometry Design of controls, man-machine information exchange. Process sheet detail and their importance, advanced techniques for higher productivity. Just -in -time and Kanban System. Modern approaches to product design; quality function development, Rapid prototyping.

**MODULE - V**

Role of computer in product design and management of manufacturing, creation of manufacturing data base, Computer Integrated Manufacturing, communication network, production flow analysis, Group Technology, Computer Aided product design and process planning. Integrating product design, F and production control.

***Suggested Readings:***

1. Niebel, B.W., and Draper, A.B., Product design and process Engineering, McGraw Hill,1974.
2. Chitale, A.K, and Gupta, R.C., Product Design and Manufacturing, Prentice Hall of India Pvt. Ltd., New Delhi,2004.
3. Mahajan, M. Industrial Engineering and Production Management, Dhanpath Rai & Co.,2000.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE009ME** | **Fracture Mechanics** | | | | | | **Elective-III** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To study about the types of failure
- To study the concepts of elastic crack
- To study the concepts related to crack growth rate and its failure
- To study about elastic –plastic fracture
- To study about crack growth law

**Course Outcomes**

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

- Understand the concepts of fracture
- Analyse the effect of crack size and its growth on the failure of the component
- Understand the mechanics related to energy release rate in crack propagation
- Determine the elastic plastic fracture mechanics
- Determine the suitable materials for the application so as to avoid fracture

**MODULE-I**

Introduction: Crack in a Structure – Griffth Criterion – Cleavage fracture – Ductile fracture – Fatigue Cracking. Service failure analysis.

**MODULE-II**

Elastic Crack: Elastic Crack tip stress field – Solution to crack problems. Effect of finite size stress intensity factor – Special cases – Irwin plastic zone correction. Actual shape of plastic zone – Plane stress – Plane strain.

**MODULE-III**

Energy Principle: Energy release rate – Criterion for crack growth – Crack resistance curve – Principles of crack arrest – Crack arrest in practice. Fatigue Crack Growth: Fatigue crack growth test, stress intensity factor, factors affecting stress intensity factor – Variable amplitude service loading, retardation model.

**MODULE-IV**

Elastic Plastic Fracture Mechanics: Elastic plastic fracture concept – Crack tip opening displacement – J-integral technique; Determination of J-using FEM.

**MODULE - V**

Application of Fracture Mechanics: Fracture design – Selection of materials – fatigue crack growth rate curve – Stress intensity factor range – Use of crack growth law.

***Suggested Readings:***

1. Broek, D., Elementary Engineering Fracture Mechanics, Springer Science & Business Media,2012.
2. John M. Barson and Stanely T. Rolfe, Fracture and Fatigue Control in Structures, Prentice Hall, 1987.
3. Jean Cemative and Jean Louis Chboche, Mechanics of Solid Materials, Cambridge University Press, 1987.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE010ME** | **Mechanics of Composite Materials** | | | | | | **Elective-III** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To study about the types of composites
- To study the properties of composites
- To study the laminar structure of composites and determine the stresses
- To study the strength and failure modes in composites
- To study the analysis of plates

**Course Outcomes:**

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

1. Understand the importance of fibres and matrix materials in preparation of various types of composites
2. Determine the micromechanics of composites
3. Determine the behavior of composite beams
4. Understand the behavior of unidirectional fibre composites and orthotropic lamina composites
5. Analyse the stresses in plates and cylindrical shells

**MODULE-I**

**Introduction:** Fibres, Matrix materials, interfaces, polymer matrix composites, metal matrix composites, ceramic matrix composites carbon fibre composites.

**MODULE-II**

**Micromechanics of Composites:** Mechanical Properties-Prediction of Elastic constant, micromechanical approach, Halpin-Tsai equations, Transverse stresses. Thermal properties-Hygrothermal stresses, mechanics of load transfer from matrix to fibre.

**MODULE-III**

**Macromechanics of Composites:** Elastic constants of a lamina, relations between engineering constants and reduced stiffness and compliances, variation of lamina properties with orientation, analysis of laminated composites, stresses and strains with orientation, inter-laminar stresses and edge effects. Simplified composite beam solutions. Bending of laminated beams.

**MODULE-IV**

**Strength, fracture, fatigue and design:** Tensile and compressive strength of unidirectional fibre composites
**Fracture modes in composites:** Single and multiple fracture, de-bonding, fibre pullout and de-lamination failure, fatigue of laminate composites. Effect of variability of fibre strength.
**Strength of an orthotropic lamina:** Max stress theory, max strain criteria, maximum work (Tsai-Hill) criterion, quadratic interaction criteria. Designing with composite materials.

**MODULE - V**

**Analysis of plates and shells:** Plate equilibrium equations, Bending of composite plates, Levy and Navier solution for plates of composite materials. Analysis of composite cylindrical shells under axially symmetric loads.

***Suggested Readings:***


1. Jones, R.M., *Mechanics of Composite Materials, McGraw Hill Co.,1999.*
2. Calcote, L.R., *The Analysis of Laminated Composite Structures,* Van Nostrand,1969.
3. Whitney, I.M. Daniel, R.B. Pipes, *Experimental Mechanics of Fibre Reinforced Composite Materials,* Prentice Hall,1984.
4. Hyer, M.W., *Stress Analysis of Fibre Reinforced Composite Materials,* McGraw Hill Co.,1998.
5. Carl. T. Herakovich, *Mechanics of Fibrous Composites,* John Wiley Sons Inc.,1998.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE011ME** | **Vibration Analysis and Condition Monitoring** | | | | | | **Elective-III** |
| | Contact Hours per Week | | | | | | |
| Prerequisite | L | T | D | P | CIE | SEE | Credits |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- Fully understand importance of vibrations in mechanical design of machine parts that operate under vibratory conditions.
- Able to write differential equation of motion of vibratory system and understand free and forced modes of vibration
- Able to obtain linear vibratory models of dynamic systems of varying complexity (SDOF, MDOF)
- Able to understand the various condition monitoring techniques available in the literature
- Able to understand the various devices available to record interpret and understand the vibration data.

**Course Outcomes**

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

1. Understand the causes of vibration and types of vibration
2. Determine the behavior of two degrees freedom systems
3. Analyse the multi degree freedom systems
4. Determine the methods that can be utilize for condition monitoring of various systems
5. Understand the various special vibration measuring techniques

**MODULE-I**

Causes and effects of vibration. Vibrations of Single Degree of freedom systems. Free, Damped and Forced vibrations

**MODULE-II**

Two Degree of freedom systems. Bending vibrations of two degree of freedom systems, Steady state and transient characteristics of vibration, vibration absorber and vibration isolation.

**MODULE-III**

Multi degree of freedom systems: Dunkerley method, Rayleigh method, Stodola method and Holzers method. Modal analysis.

**MODULE-IV**

Introduction to Condition Monitoring, Failure types, investigation and occurrences. Causes of failure, Vibration measuring instruments, vibration transducers, signal conditioning elements. Display and recording elements. Vibration meters and analyzers. Condition Monitoring through vibration analysis. Frequency analysis, Filters, Vibration signature of active systems, vibration limits and standards.

**MODULE - V**

Contaminant analysis, SOAP and other contaminant monitoring techniques. Special vibration measuring techniques - Change in sound method, Ultrasonic measurement method, Shock pulse measurement, Kurtosis, Acoustic emission monitoring, Cepstrum analysis, Modal analysis, critical speed analysis, Shaft –orbit & position analysis.

***Suggested Readings:***


1. Rao S. S Mechanical Vibrations, 6th Edition, Prentice Hall,2018
2. V.P. Singh, Mechanical vibrations, Dhanpat Rai Publications,2021.
3. Collacott, R.A., *Mechanical Fault Diagnosis and Condition Monitoring,* Chapman & Hall, London, 1982.
4. John S. Mitchell, *Introduction to Machinery Analysis and Monitoring,* Penn Well Books, Penn Well Publishing Company, Tulsa, Oklahoma, 1993.
5. J S Rao, Vibration condition monitoring of machines, CRC Press,2000
6. Nakra, B.C. Yadava, G.S. and Thuested, L., *Vibration Measurement and Analysis,* National Productivity Council, New Delhi,1989.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE012ME** | **Smart Materials and Sensors** | | | | | | **Elective-III** |
| Prerequisite | Contact hours per week | | | | CIE | SEE | Credits |
| Material science, Instrumentation | L | T | D | P | | | |
| | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives:**

The objectives of this course are

- To impart in-depth knowledge of the types, properties, manufacturing, sensing, and actuation mechanisms of smart materials and their role in automated industries.

**Course Outcomes:**

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

- Classify various types of smart materials and explain their components, advantages, limitations, and applications in engineering and mechatronics systems.
- Describe the properties and working principles of smart functional materials such as piezoelectric, magnetostrictive, electrostrictive materials, and shape memory alloys/polymers.
- Analyze different processing techniques for semiconductors, metals, ceramics, and polymers, including metallization and UV curing methods.
- Evaluate various sensor types and sensing techniques for specific engineering applications.
- Select and justify suitable actuator types for industrial applications such as cranes, hoists, monorails, and automated systems.

**MODULE-I:**

Overview of smart materials, Classification of smart materials, Components of smart material systems, Advantages and disadvantages, Applications in engineering, and mechatronics systems

**MODULE-II:**

**Smart Functional Materials:**

Piezoelectric materials, Electrostrictive materials, Magnetostrictive materials, Magnetoelectric materials, Magnetorheological and Electrorheological fluids, shape memory alloys and polymers.

**MODULE-III:**

**Processing of Materials:**

Processing of semiconductors, metals, ceramics, and polymers; metallization techniques; UV radiation curing of polymers.

**MODULE-IV:**

**Sensors and Sensing Techniques:**

Types of sensors: conductometric, capacitive, piezoelectric, piezoresistive, magnetostrictive, optical, resonant, semiconductor, acoustic, polymer, and CNT-based sensors.

**MODULE-V:**

**Actuators and Industrial Applications**

Electrostatic, electromagnetic, electrodynamic, piezoelectric, electrostrictive, magnetostrictive, electrothermal actuators; applications in cranes, hoists, monorails, and automation systems.

***Suggested Readings:***

1. M.V. Gandhi & B.S. Thompson, Smart Materials and Structures, Chapman and Hall,1992.
2. A.V. Srinivasan, Smart Materials and Structures, Cambridge University Press,2001.
3. John Vetelino & Aravind Reghu, Introduction to Sensors, CRC Press,2011.
4. Clarence W. de Silva, Sensors and Actuators, CRC Press.
5. Vijay K. Varadan et al., Smart Materials Systems and MEMS, Wiley.
6. Chin-Lin Wu, Characterization of Smart Materials, Elsevier.

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| **P25PE013ME** | **Tribology In Design** | | | | | | **Elective-IV** |
| Prerequisite | Contact hours per week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Design of Machine Elements | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- Introduction to fundamental concepts of tribology including friction, wear, and lubrication.
- Enable analysis and design of tribological components such as bearings and gears.
- Provide understanding of surface engineering, coatings, and contact mechanics, lubricant and additive selection strategies.
- To understand friction characteristics and power losses in journal bearings.
- Familiarize students with tribological testing, instrumentation, and monitoring techniques.

**Course Outcomes**

On completion of course, students will be able to

- Understand the tribological principles relevant to mechanical system design.
- Understand the role of friction and wear and its measurement.
- Understand the hydro static & hydro dynamic theory of lubrication.
- Knowledge about different theories of lubrication to reduce friction and wear.
- Understand the application to Hydrodynamic journal bearings, concepts of lubrication and dry friction.

**MODULE-I:**

**Introduction:** Study of various parameters: Viscosity, flow of fluids, viscosity and its variation, absolute and kinematic viscosity, temperature dependent variation, viscosity index, determination of viscosity, different viscometers used. Hydrostatic lubrication: Hydrostatic step bearing, application to pivoted pad thrust bearing and other applications, hydrostatic lifts, hydrostatic squeeze films and its application to journal bearing.

**MODULE-II:**

Hydrodynamic theory of lubrication**:** Various theories of lubrication, petroffs equation, Reynold's equation in two dimensions - Effects of side leakage - Reynolds equation in three dimensions, Friction in sliding bearing, hydro-dynamic theory applied to journal bearing, minimum oil film thickness, oil whip and whirl anti -friction bearing.

**MODULE-III:**

Friction and power losses in journal bearings Calibration of friction loss, friction in concentric bearings, bearing moduIus, Sommer-field number, heat balance, practical considerations of journal bearing design.

**MODULE-IV:**

Air lubricated bearing: Advantages and disadvantages, application to Hydrodynamic journal bearings, hydrodynamic thrust bearings. Hydrostatic thrust bearings. Hydrostatic bearing Analysis including compressibility effect. Study of current concepts of boundary friction and dry friction.

**MODULE-V:**

Types of bearing oil pads: Hydrostatic bearing wick oiled bearings, oil rings, pressure feed bearing, partial bearings -externally pressurized bearings. Bearing materials: General requirements of bearing materials, types of bearing materials.

***Suggested Readings:***


1. Engineering Tribology, Gwidon W. Stachowiak & Andrew W. Batchelor, Elesevier, 5th edition 2025.
2. Engineering Tribology Prasanta Sahoo PHI Learning Private Ltd, New Delhi 2011
3. Introduction to Tribology B. Bhushan John Wiley & Sons, Inc., New York, 2011
4. Tribology in Industry : Sushil Kumar Srivatsava, S. Chand &Co.
5. Tribology – B.C. Majumdar, McGraw Hill Co Ltd.
6. Fundamentals of Tribology, Basu, SenGupta and Ahuja/PHI
7. Tribology Hand Book, Michel Ncole
8. Lubrication, Raymono O. Gunther; Bailey Bros & Swinfan Ltd
9. Engineering Tribology – G. W. Stachowiak & A. W. Batchelor (Elsevier)
10. Engineering Tribology – Prasanta Sahoo, PHI Learning Pvt. Ltd., 2011
11. Introduction to Tribology – Bharat Bhushan, Wiley, 2002

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE014ME** | **Augmented Reality and Virtual Reality (AR/VR)** | | | | | | **Elective-IV** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

To understand the basic concepts of Virtual and Augmented Reality

- To identify the differences in AR/VR concepts and technologies
- To understand the fundamental concepts relating to Virtual Reality such as presence, immersion, and engagement
- To evaluate usability of AR/VR applications and critique their use of AR/VR capabilities.
- To design and prototype effective AR/VR applications using UNITY platform for business, industry, non-profit and government organizations.

**Course Outcomes**

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

- Introduce role of augmented and virtual reality in interactive application development.
- Apply Geometric Modelling Techniques
- Implement virtual environment with respect to user experience.
- Design Virtual/Augmented Reality Applications
- Acquire fundamental and hands-on skills needed to develop AR/VR applications.

**MODULE-I**

Introduction to Augmented Reality (AR): Definition and Scope A Brief History of Augmented Reality Displays (Multimodal Displays, Spatial Display Model, and Visual Displays) Strong vs Weak AR Applications of AR Challenges in AR .

**MODULE-II**

Introduction to Virtual Reality (VR): Definition and Scope Types of VR Characteristics of VR Basic VR environments Limitations of VR environments Immersion Vs Presence Key hardware requirements for VR.

**MODULE-III**

Interaction Design for AR/VR Environments: Interaction design process Identifying user needs AR/VR design considerations Typical AR/VR Interface Metaphors Affordances in AR/VR Human Information Processing Design for Perception and cognition User experience (UX) guidelines for AR/VR UX challenges for AR/VR Prototyping for AR/VR Evaluation of the developed AR/VR prototype.

**MODULE-IV**

Unity Overview: Windows, Interface, Navigation, Terminology, Game Objects, Hierarchy, Parenting Objects Asset Store, Importing Plug-ins Creating a Terrain, Materials, Colors, Transparency Introduction to Monobehaviour: Awake, Start, Update.

**MODULE-V**

Introduction to Vuforia and Physics in UNITY Vuforia Overview: Interface, Navigation, Terminology, Image Targeting, Custom Images Overview of Physics in Unity Introduction to Scripting: Terminology, Creating Objects, Accessing Components, Debugging, Lists, Loops.

***Suggested Readings:***


1. Understanding virtual reality, Sherman W. R., & Craig A. B., Morgan Kauffman, 2003
2. Augmented Reality: Principles and Practice, Schmalstieg D., & Hollerer T., AddisonWesley Professional, 2016
3. A survey of augmented reality. Presence: Teleoperators & Virtual Environments, Azuma R. T., 1997, 6(4), 355–385
4. Recent Advances in Augmented Reality, IEEE Computer Graphics and Applications, Azuma R., Baillot Y., Behringer R., Feiner S., Julier S., & MacIntyre B., 2001, 21(6), 34-47
5. A Cost-Effective Interactive 3D Virtual Reality System Applied To Military Live Firing Training, Virtual Reality, Bhagat K. K., Liou, W. K., & Chang, C. Y, 2016, 20(2), 127- 140. doi:10.1007/s10055-016-0284-x
6. Augmented Reality Technologies, Systems and Applications, Multimedia Tools and Applications, Carmigniani J., Furht B., Anisetti M., Ceravolo P., Damiani E., & Ivkovic M., 2011, 51(1), 341-377
7. Human Augmentation: Past, Present and Future. International Journal of Human Computer Studies, Raisamo R., Rakkolainen I., Majaranta P., Salminen K., Rantala J., & Farooq, 2019, 131, 131-143. doi: https://doi.org/10.1016/j.ijhcs.2019.05.008.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE015ME** | **Industrial IoT** | | | | | | **Elective-IV** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- Understand foundations of Industrial IoT and Cyber Physical Systems
- Identify IIoT Infrastructure and Components
- Extract Industrial Data Acquisition Systems Processing and Cloud Computing
- Categorise Cyber-Physical Systems and their Integration into Industrial System
- Appraise IIoT Use Cases and Industrial Applications

**Course Outcomes**

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

- Summarize foundations of Industrial IoT and Cyber Physical Systems
- Explain IIoT Infrastructure and Components
- Interpret Industrial Data Acquisition Systems Processing and Cloud Computing
- Classify Cyber-Physical Systems and their Integration into Industrial System
- Outline IIoT Use Cases and Industrial Applications

**MODULE-I**

**Foundations of IIoT and Industry 4.0:** - Evolution of Industrial Revolutions (Industry 1.0 to 4.0), Principles and architecture of Industry 4.0, Role of IoT and IIoT in modern manufacturing, Overview of Cyber-Physical Systems (CPS), Introduction to Smart Manufacturing and Smart Factories, Enablers of Industry 4.0: AI, Robotics, Big Data

**MODULE-II**

**IIoT Infrastructure and Components:** Sensors and actuators in industrial environments, Wireless communication protocols: ZigBee, LoRa, Bluetooth, Wi-Fi, Embedded systems and microcontrollers in IIoT, Gateways, Edge Devices, and Industrial Routers, IIoT Platforms and Middleware (ThingWorx, AWS, Azure)

**MODULE-III**

**Data Acquisition, Processing, and Cloud Integration:** Industrial data acquisition systems, Cloud computing for IIoT (AWS IoT Core, Azure IoT Hub), Edge and Fog Computing: Concepts and applications, Real-time analytics and streaming data, IIoT data pipelines: from sensors to cloud, Predictive maintenance and machine diagnostics

**MODULE-IV**

**Cyber-Physical Integration and Advanced Technologies:** Advanced CPS integration in industrial systems, Artificial Intelligence in IIoT (machine learning, automation), Augmented Reality (AR) & Virtual Reality (VR) applications, Big Data and Industrial Analytics, Digital Twins and their role in Industry 4.0, Product Lifecycle Management (PLM)

**MODULE-V**

**IIoT Use Cases and Industry Applications:** Healthcare and medical monitoring systems, Power and energy sector applications (smart grids, turbines), Inventory management and logistics, Factory automation and smart production lines, Plant safety, remote diagnostics, and maintenance, Industrial security and compliance

***Suggested Readings:***

1. *"Industrial Internet of Things: Cyber manufacturing Systems"* by Sabina Jeschke Christian Brecher, Houbing Song, Danda B. Rawat (Springer),2017.
2. *"Industry 4.0 The Industrial Internet of Things"* by Alasdair Gilchrist (Apress)

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PE016ME** | **Reverse Engineering** | | | | | | **Elective-III** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **CAD/CAM** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

The objectives of the course are to make the students learn about

- Introduce the concepts of reverse engineering
- Familiarize with the tools and techniques for reverse engineering
- Teach the principles of various rapid prototyping methods
- Discuss the legal aspects of reverse engineering.

**Course Outcomes**

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

- Define reverse engineering and describe its scope, tasks, and generic process.
- Explain the tools and techniques used in reverse engineering, including object scanning and point data processing.
- Apply reverse engineering methods to develop geometric, surface, and solid models from scanned data.
- Analyze various rapid prototyping techniques and materials to classify their applications, benefits, and limitations.
- Evaluate the integration of reverse engineering with structured methods and legal frameworks, including copyright considerations.

**MODULE-I**

**Introduction**

Scope and tasks of RE, Process of duplicating, Definition and use of Reverse Engineering, Reverse Engineering as a Generic Process.

**MODULE-II**

**Tools and Techniques for RE**

Object scanning: contact scanners, noncontact scanners, destructive method, coordinate measuring machine, Point Data Processing: pre processing and post processing of captured data, geometric model development, construction of surface model, solid model, noise reduction, feature identification, model verification.

**MODULE-III**

**Rapid Prototyping**

Introduction, current RP techniques and materials, Stereo Lithography, Selective Laser Sintering, Fused Deposition Modelling, Three-dimensional Printing, Laminated Object Manufacturing, Multi – jet Modelling, Laser-engineered Net Shaping, Rapid Prototyping, Rapid Tooling, Rapid Manufacturing.

**MODULE-IV**

**Integration**

Cognitive approach to RE, Integration of formal and structured methods in reverse engineering, Integration of reverse engineering and reuse.

**MODULE-V**

**Legal Aspects of Reverse Engineering**

Legal Aspects of Reverse Engineering: Introduction, Copyright Law.

***Suggested Readings:***

1. Biggerstaff T. J., "Design Recovery for Maintenance and Reuse", IEEE Corporation, 1991.
2. Katheryn, A. Ingle, "Reverse Engineering", McGraw-Hill, 1994.
3. Aiken Peter, "Data Reverse Engineering", McGraw-Hill, 1996.
4. Linda Wills, "Reverse Engineering",Kluiver Academic Publishers, 1996.
5. Donald R. Honsa, "Co-ordinate Measurement and reverse engineering", American Gear Manufacturers Association, 1996.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25MC001ME** | **Research Methodology and IPR** | | | | | | **Mandatory Course** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

To make students to

- Motivate to choose research as career
- Formulate the research problem, prepare the research design
- Identify various sources for literature review and data collection report writing
- Equip with good methods to analyse the collected data
- Know about IPR copyrights

**Course Outcomes**

At the end of this course, students will be able to**:**

- Define research problem, review and asses the quality of literature from various sources
- Improve the style and format of writing a report for technical paper/ Journal report, understand and develop various research designs
- Collect the data by various methods: observation, interview, questionnaires.
- Analyse problem by statistical techniques: ANOVA, F-test, Chi-square
- Understand apply for patent and copyrights

**MODULE - I**

**Research Methodology:** Objectives and Motivation of Research, Types of Research, research approaches, Significance of Research, Research Methods Verses Methodology, Research Process, Criteria of Good Research, Problems Encountered by Researchers in India, Benefits to the society in general. Defining the Research Problem: Selection of Research Problem, Necessity of Defining the Problem

**MODULE - II**

**Literature Survey and Report writing:** Importance and purpose of Literature Survey, Sources of Information, Assessment of Quality of Journals and Articles, Need of Review, Guidelines for Review, Record of Research Review.

**Report writing:** Meaning of interpretation, layout of research report, Types of reports, Mechanism of writing a report. **Research Proposal Preparation**: Writing a Research Proposal and Research Report, Writing Research Grant Proposal.

**MODULE - III**

**Research Design:** Meaning of Research Design, Need of Research Design, Feature of a Good Design, Important Concepts Related to Research Design, Different Research Designs, Basic Principles of Experimental Design, Developing a Research Plan, Steps in sample design, types of sample designs.

**MODULE - IV**

**Data Collection and Analysis:** Methods of data collection, Data organization, Methods of data grouping, Diagrammatic representation of data, Graphic representation of data. Importance of Parametric, non- parametric test, testing of variance of two normal populations, use of Chi-square, ANOVA, F-test, z-test

**MODULE - V**

**Intellectual Property Rights:** Meaning, Nature, Classification and protection of Intellectual Property, The main forms of Intellectual Property, Concept of Patent, Patent document, Invention protection, Granting of patent, Rights of a patent, Licensing, Transfer of technology.

***Suggested Readings:***


1. C.R Kothari, Research Methodology, Methods & Techniquel; New Age International Publishers, 2004
2. R.Ganesan,ResearchMethodologyforEngineersl,MJPPublishers,2011
3. Y.P. Agarwal, Statistical Methods: Concepts, Application and Computation,Sterling Publications Pvt. Ltd., New Delhi, 2004
4. G.B. Reddy, Intellectual Property Rights and the Law 5th Ed. 2005 Gogia LawAgency
5. AjitParulekar and Sarita D'Souza, Indian Patents Law – Legal & Business Implications, Macmillan India Ltd, 2006.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25OE001CE** | **Green Building Technology** | | | | | | **Open Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **3** | - | - | - | **40** | **60** | **3** |

**Course Objectives**

- To provide an in-depth understanding of green building principles, including energy-efficient design, sustainable materials, and ecological systems.
- To equip students with skills to design, analyse, and implement green building systems that meet global performance standards (e.g., LEED, GRIHA, Passive House).
- To explore advanced technologies for energy conservation, water conservation, and indoor air quality in buildings.
- To develop expertise in assessing the life cycle and embodied energy of building materials and systems.
- To foster the ability to integrate renewable energy systems and sustainable practices into building design and construction.

**Course Outcomes**

- Analyse and design green buildings using principles of energy efficiency, passive solar design, and sustainable construction techniques.
- Evaluate and apply green building standards (e.g., LEED, GRIHA, ECBC) to assess building performance.
- Implement advanced technologies for energy management, water conservation, and indoor air quality in buildings.
- Conduct life cycle assessments (LCA) and calculate embodied energy for sustainable material selection.
- Design and integrate renewable energy systems, such as solar photovoltaics and thermal systems, into building projects.

**UNIT-I**

**Introduction to Green Building Concepts**

**Overview of green buildings:** Definitions, benefits, and global trends. India overview-Over 40% of total energy consumption, 40% of carbon emissions, 20% of raw material use, 20% of water use, and 30% of solid waste generation.

**Principles of energy-conscious design:** Climate-responsive architecture and sustainable construction. Green building standards: LEED, GRIHA, Living Building Challenge, ECBC.

Case studies: Green buildings in India and globally.

**UNIT-II**

**Building Science and Energy Efficiency**

Anatomy of a building: Thermal and pressure envelopes, insulation, air sealing. Heat and moisture transfer in buildings: Dew point, condensation management. Passive solar design: Orientation, shading, and thermal mass.

Energy-efficient construction: Thermally-efficient methods, Energy auditing: ECA-2001.

**UNIT-III**

**Sustainable Materials and Construction Technologies**

Life cycle assessment (LCA) and embodied energy of building materials. Alternative building materials: Rammed earth, COB, adobe, recycled aggregates. Low/no cement concrete. stimulus responsive smart materials.

Cost-effective technologies: Prefabricated buildings, Tiny House concepts.

**UNIT-IV**

**Indoor Environmental Quality and Ecological Design**

Indoor air quality: Ventilation strategies, microbial biome, sick building syndrome. Toxins in buildings: Lead, asbestos, and safe renovation strategies. Ecological design: Biomimicry, greywater systems, rainwater harvesting. Green building codes and indoor environmental quality standards.Plants as air purifiers and biologically diverse landscape systems.

**UNIT-V**

**Renewable Energy Integration in Green Buildings & Intelligent Buildings**

Solar photovoltaic and thermal energy systems: Design and integration. Waste-to-energy systems: Biogas, solid waste management. Net-zero energy buildings

**Intelligent Buildings-Building Automation-Smart buildings- Building services in high rise buildings.**

***Suggested Readings:***


1. Shapiro, Ian M. Energy Audits and Improvements for Commercial Buildings. Wiley, 2024.
2. Solanki, C.S.Solar Photovoltaics: Fundamentals, Technologies and Applications. PHI Learning, 2024.
3. Low Energy Cooling for Sustainable Buildings. John Wiley and Sons Ltd, 2023.
4. Yudelson, Jerry. Green Building Through Integrated Design. McGraw Hill, 2022.
5. Ashby, Michael F. Materials and the Environment: Eco-informed Material Choice. Elsevier, 2021.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25OE002CS** | **Business Analytics** | | | | | | **Open Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

## Course Objectives:

To make students to

- Understand the fundamentals, process, and scope of Business Analytics.
- Apply statistical, data mining, and predictive modeling techniques for decision making.
- Learn data visualization and interpretation for effective business insights.
- Use optimization and simulation for business problem-solving.
- Explore real-world business applications of analytics and emerging trends.

## Course Outcomes:

At the end of this course, students will be able to**:**

- Students will demonstrate knowledge of data analytics
- Students will demonstrate the ability of think critically in making decisions based on data and deep analytics.
- Students will demonstrate the ability to use technical skills in predicative and prescriptive modelling to support business decision-making
- Students will demonstrate the ability to translate data in to clear, actionable in sights
- Students will solve industry-specific problems and understand research formulation and patent procedures

**MODULE-I**

**Introduction to Business Analytics:** Definition, scope, and importance of Business Analytics,
Analytics process: Descriptive, Predictive, and Prescriptive Analytics, Role of data in decision-making, Data types, sources, and collection methods, Business Intelligence vs. Business Analytics,
Applications across domains – marketing, finance, HR, supply chain.

**MODULE-II**

**Descriptive Analytics and Data Exploration:** Data summarization and visualization techniques,
Statistical measures: mean, median, variance, correlation, Data cleaning and preparation,
Dashboards and reporting tools (Excel, Power BI, Tableau introduction), Case studies on descriptive analytics.

**MODULE-III**

**Predictive Analytics:** Regression analysis (simple & multiple), , Time series forecasting, Classification techniques (logistic regression, decision trees), Evaluation metrics ($R^2$, RMSE, accuracy), Applications in demand forecasting, risk assessment, customer churn prediction.

**MODULE-IV**

**Prescriptive Analytics and Optimization:** Concept of optimization in decision making, Linear programming models, Simulation modeling, Decision analysis under uncertainty, Use of Solver in Excel / Python optimization tools .

**MODULE-V**

**Applications and Emerging Trends:**

Business analytics applications in different sectors, Case studies (retail, banking, healthcare, manufacturing, government), Data privacy, ethics, and governance in analytics, Artificial Intelligence and Machine Learning in Business Analytics, Recent tools and technologies (R, Python, Tableau, Power BI, SAS).

**Text Books:**

1. James R. Evans – Business Analytics, Pearson
2. Albright & Winston – Business Analytics: Data Analysis and Decision Making, Cengage
3. Foster Provost & Tom Fawcett – Data Science for Business, O'Reilly
4. Wayne L. Winston – Operations Research: Applications and Algorithms, Cengage
5. Thomas Davenport – Analytics at Work: Smarter Decisions, Better Results, Harvard Press

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| P25OE003EC | Fundamentals of Embedded System Design | | | | | | Open Elective |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Microcontrollers | 3 | - | - | | 40 | 60 | 3 |

**Course Objectives**

- Discuss embedded system architectures, challenges and design issues.
- Describe PIC microcontroller, its features and programming.
- Illustrate ARM Microcontroller architectural details and instruction set.
- Explain ARM Memory management.
- Explore the embedded software tools to develop an embedded system.

**Course Outcomes**

- Understand embedded system architectures, challenges and design issues.
- Explain PIC microcontroller, its features and programming.
- Analyze ARM Microcontroller architectural details and instruction set.
- Understand ARM Memory management.
- Apply the embedded software tools to develop an embedded system.

***MODULE I***

**Introduction to Embedded Systems:** Overview of Embedded System Architecture, Challenges & Trends of Embedded Systems, Hardware Architecture, Software Architecture. Application areas of Embedded Systems & Categories of Embedded Systems. Embedded System Design & Co-Design issues and Design Cycle Process.

***MODULE II***

**PIC 18:** Family Overview, Architecture, Instruction Set, Addressing modes. Timers and Interrupts of PIC 18 and Capture/Compare and PWM modules of PIC 18.

***MODULE III***

**ARM Architecture:** ARM Design Philosophy, Registers, Program Status Register, Instruction Pipeline, Interrupts and Vector Table, Architecture Revision, ARM Processor Families. Instruction Set: Data Processing Instructions, Addressing Modes, Branch, Load, Store Instructions, PSR Instructions, Conditional Instructions.

***MODULE IV***

**ARM Thumb Instruction Set:** Register Usage, Other Branch Instructions, Data Processing Instruction Single-Register and Multi Register Load-Store Instructions, Stack, Software Interrupt Instructions. Exception and interrupt handling.

**ARM Memory Management:** Cache Architecture, Polices, Flushing and Caches, MMU, Page Tables, Translation Access Permissions, Context Switch.

***MODULE V***

**Embedded Software Development Tools:** Embedded Software Development Tools, Host and Target Machines, Linkers/Locators for Embedded Software, Getting Embedded Software into the Target System. Debugging Techniques.

***Suggested Readings:***


1. Raj Kamal, "Embedded Systems – Architecture, Programming and Design", 2nd Edition, TMH, 2008.
2. Andrew N. Sloss, Dominic Symes, Chris Wright, "ARM Systems Developer's Guides – Designing & Optimizing System Software", Elsevier, 2008.
3. Mazidi, MCKinlay and Danny Causey, "PIC Microcontrollers and Embedded Systems", Pearson Education, 2007
4. David.E.Simon, "An Embedded Software Primer," 1st Edition, Pearson Education, 1999.
5. Jonathan W. Valvano, "Embedded Microcomputer Systems, Real Time Interfacing", Thomas Learning, 1999.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25OE004EE** | **Waste to Energy** | | | | | | **Open Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- To enable students to aware about the generation of energy from the waste.

**Course Outcomes**

At the end of this course, students will be able to**:**

- Students should able to learn the Classification of waste as a fuel.
- Students should able to learn the Manufacture of charcoal.
- Students should able to carry out the designing of gasifiers and bio mass stoves.
- Student should able to learn the Biogas plant technology.

**MODULE-I**

**Introduction to Energy from Waste:** Classification of waste as fuel – Agro based, Forest residue, Industrial waste - MSW – Conversion devices – Incinerators, gasifiers, digestors. Biomass Pyrolysis: Pyrolysis – Types, slow fast – Manufacture of charcoal – Methods - Yields and application – Manufacture of pyrolytic oils and gases, yields and applications.

**MODULE-II**

**Biomass Gasification:** Gasifiers – Fixed bed system – Downdraft and updraft gasifiers – Fluidized bed gasifiers – Design, construction and operation – Gasifier burner arrangement for thermal heating – Gasifier engine arrangement and electrical power – Equilibrium and kinetic consideration in gasifier operation.

**MODULE-III**

**Biomass Combustion:** Biomass stoves – Improved chullahs, types, some exotic designs, fixed bed combustors, Types, inclined grate combustors, Fluidized bed combustors, Design, construction and operation - Operation of all the above biomass combustors.

**MODULE-IV**

**Biogas:** Properties of biogas (Calorific value and composition) - Biogas plant technology and status - Bio energy system - Design and constructional features - Biomass resources and their classification - Biomass conversion processes - Thermo chemical conversion - Direct combustion - biomass gasification - pyrolysis and liquefaction

**MODULE - V**

**Biochemical conversion:** Anaerobic digestion - Types of biogas Plants – Applications - Alcohol production from biomass - Bio diesel production - Urban waste to energy conversion - Biomass energy programme in India.

***Suggested Readingss:***

1. Non-Conventional Energy, Desai, Ashok V., Wiley Eastern Ltd.,1990.
2. Biogas Technology - A Practical Hand Book, Khandelwal, K. C. and Mahdi, S. S., Vol. I & II, Tata McGraw Hill Publishing Co. Ltd.,1983.
3. Food, Feed and Fuel from Biomass, Challal, D. S., IBH Publishing Co. Pvt. Ltd.,1991.
4. Biomass Conversion and Technology, C. Y. WereKo-Brobby and E. B. Hagan, John Wiley & Sons,1996.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25OE005ME** | **Industrial Safety** | | | | | | **Open Elective** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **3** | **-** | **-** | **-** | **40** | **60** | **3** |

**Course Objectives**

- Causes for industrial accidents and preventive steps to be taken.
- Fundamental concepts of Maintenance Engineering.
- About wear and corrosion along with preventive steps to betaken
- The basic concepts and importance of fault tracing.
- The steps involved in carrying out periodic and preventive maintenance of various equipment used in industry.

**Course Outcomes**

After completing this course, the student will be equipped with:

- concepts of engineering systems safety
- Identify the causes for industrial accidents and suggest preventive measures.
- Identify the basic tools and requirements of different maintenance procedures.
- Apply different techniques to reduce and prevent Wear and corrosion in Industry.
- Identify different types of faults present in various equipment's like machine tools, IC Engines, boilers etc.
- Apply periodic and preventive maintenance techniques as required for industrial equipment's like motors, pumps and air compressors and machine tools etc.

**MODULE-I**

**Industrial safety**: Accident, causes, types, results and control, mechanical and electrical hazards, types, causes and preventive steps/procedure, describe salient points of factories act 1948 for health and safety, washrooms, drinking water layouts, light, cleanliness, fire, guarding, pressure vessels, etc., Safety color codes. Fire prevention and firefighting, equipment, and methods.

**MODULE-II**

**Fundamentals of maintenance engineering**: Definition and aim of maintenance engineering, Primary and secondary functions and responsibility of maintenance department, Types of maintenance, Types and applications of tools used for maintenance, Maintenance cost & its relationship with replacement economy, Service life of equipment.

**MODULE-III**

**Wear and Corrosion and their prevention**: Wear- types, causes, effects, wear reduction methods, lubricants-types and applications, Lubrication methods, general sketch, working and applications, i. Screw down grease cup, ii. Pressure grease gun, iii. Splash lubrication, iv. Gravity lubrication, v. Wick feed lubrication vi. Side feed lubrication, vii. Ring lubrication, Definition, principle and factors affecting the corrosion. Types of corrosion, corrosion prevention methods.

**MODULE-IV**

**Fault tracing**: Fault tracing-concept and importance, decision tree concept, need and applications, sequence of fault-finding activities, show as decision tree, draw decision tree for problems in machine tools, hydraulic, pneumatic, automotive, thermal and electrical equipment's like, I. Any one machine tool, ii. Pump iii. Air compressor, iv. Internal combustion engine, v. Boiler, vi. Electrical motors, Types of faults in machine tools and their general causes.

**MODULE – V**

**Periodic and preventive maintenance:** Periodic inspection-concept and need, degreasing, cleaning and repairing schemes, overhauling of mechanical components, overhauling of electrical motor, common troubles and remedies of electric motor, repair complexities and its use, definition, need, steps and advantages of preventive maintenance. Steps/procedure for periodic and preventive maintenance of: I. Machine tools, ii. Pumps, iii. Air compressors, iv. Diesel generating (DG) sets, Program, and schedule of preventive maintenance of mechanical and electrical equipment, advantages of preventive maintenance. Repair cycle concept and importance.

***Suggested Readings:***

1. Maintenance Engineering Handbook, Higgins & Morrow, Da Information Services.
2. Maintenance Engineering, H. P. Garg, S. Chand and Company.
3. Pump-hydraulic Compressors, Audels, McGraw Hill Publication
4. Foundation Engineering Handbook, Winterkorn, Hans, Chapman & Hall London

| Course Code | Course Title | | | | | | Core / Elective |
|---|---|---|---|---|---|---|---|
| **P25OE006ME** | **Operations Research** | | | | | | **Open Elective** |
| Prerequisite | Contact Hours per week | | | | CIE | SEE | Credits |
| | L | T | P | D | | | |
| Engineering Mathematics | 3 | - | - | - | 40 | 60 | 3 |

**Course Objectives**

The objectives of this course are to

- Use variables for formulating complex mathematical models in management science, industrial engineering and transportation models.
- Use the basic methodology for the solution of linear programming problems.
- Understand the mathematical tools that are needed to solve optimization problems like Transportation models and Assignment models.
- Understand the replacement models with change in money value considering with time and without time.
- Model a system as a queuing model and compute important performance measures.

**Course Outcomes**

Upon completion of course, students will be able to

- Paraphrase the real time problem and develop a graphical or analytical linear programming model for maximization or minimization condition.
- Categorize complex linear programming problem and apply duality concept for developing optimum Solution model.
- Construct cost minimization model for transportation and resource allocation situations.
- Recommend optimum criteria for maintenance and conflict situations by implementing suitable models
- Analyse waiting line, resource scheduling situations and develop optimum solution.

**MODULE -I**

**Introduction:** Definition, scope, applications of Operations Research

**Linear Programming:** Introduction, formulation of linear programming problems, graphical method of solving LP problem, simplex method, maximization and minimization.

**Duality:** Definition, relationship between primal and dual, formation of dual problem.

**MODULE -II**

**Transportation Models:** Finding an initial/basic feasible solution – North West Corner method, Least cost method, Vogel's Approximation method, finding the optimal solution - optimal solution by stepping stone and MODI methods, Special cases in Transportation problems - Unbalanced Transportation problem.

**MODULE -III**

**Assignment Problems:** Hungarian method of Assignment problem, Maximization in Assignment problem, travelling salesman problem.

**Replacement Models:** Introduction, replacement of items that deteriorate ignoring change in money value, replacement of items that deteriorate considering change in money value with time

**MODULE -IV**

**Sequencing Models:** Introduction, General assumptions, processing 'n' jobs through 2 machines, processing 'n' jobs through 3 machines, Processing 2 jobs through 'm' machines.

**MODULE -V**

**Game Theory:** Introduction, 2 person zero sum games, Maximin – Minimax principle, Principle of Dominance, Solution for mixed strategy problems.

**Queuing Theory:** Introduction to queuing system, Kendall's notation for representing queuing models, single channel – Poisson arrivals – exponential service times with infinite population

***Suggested Readings***:


1. Operations Research – An Introduction, Hamdy, A. Taha, 6th Edition, Prentice Hall of India Pvt. Ltd., 1997.
2. Operations Research, S.D. Sharma, Kedarnath, Ramnath & Co., Meerut, 2009.
3. Operations Research, S. Kalavathy, 4th Edition, Vikas Publishing House Pvt. Ltd., 2018.
4. Introduction to Operations Research, Fredrick Hiller and Gerald Lieberman, McGraw Hill Publishing Company, 11th Edition, 2021.
5. Operations Research, P. Sankara Iyer, Tata McGraw-Hill Publishing Company Ltd., 2009
6. Operations Research, V.K. Kapoor, S. Chand Publishers, New Delhi, 2004.
7. Operations Research, R. Panneer Selvam, 2nd Edition, Prentice hall of India Learning Pvt. Ltd., New Delhi, 2008.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| P25OE007CS | Fundamentals of Machine Learning | | | | | | Open Elective |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | 3 | - | - | - | 40 | 60 | 3 |

**Course Objectives:**

To make students to

- Understand core ML concepts, learning types, and the ML project workflow.
- Apply supervised learning methods for regression and classification.
- Use unsupervised techniques for clustering and dimensionality reduction.
- Explain and employ advanced methods (ensembles, SVMs, basic neural nets).
- Tune, deploy ML models responsibly, considering ethics and interpretability.

**Course Outcomes:**

At the end of this course, students will be able to**:**

- Students will be able to explain ML fundamentals, identify different learning paradigms, and
- Understand the workflow of an ML project.
- Students will be able to build regression and classification models and evaluate their performance effectively.
- Students will be able to apply clustering and dimensionality reduction methods to extract patterns from unlabeled data.
- Students will gain knowledge of advanced ML techniques and understand the basics of neural networks and ensemble models.
- Students will be able to perform model optimization and deployment while considering ethical and practical aspects.

**Module I:**

**Introduction to Machine Learning:** Definition and scope of Machine Learning, Types of Learning: Supervised, Unsupervised, Semi-supervised, Reinforcement Learning, Applications of ML in various domains (Healthcare, Finance, Agriculture, Education, etc.), Steps in a Machine Learning Project, Key concepts: Features, Labels, Training, Testing, Validation, Overview of ML tools and environments (Python, Scikit-learn, TensorFlow, etc.)

**Module II:**

**Supervised Learning:** Regression Techniques: Linear, Multiple Linear, Polynomial Regression, Classification Algorithms: Logistic Regression, k-NN, Decision Trees, Naïve Bayes, Evaluation Metrics: Confusion Matrix, Accuracy, Precision, Recall, F1-Score, ROC Curve, Bias-Variance Trade-off and Model Generalization

**Module III:**

**Unsupervised Learning:** Concept and need for Unsupervised Learning, Clustering Algorithms: K-Means, Hierarchical Clustering, DBSCAN, Dimensionality Reduction: Principal Component Analysis (PCA), t-SNE, Association Rule Mining: Apriori and FP-Growth algorithms, Evaluation Metrics for Clustering

**Module IV:**

**Advanced Machine Learning Concepts:** Ensemble Methods: Bagging, Boosting, Random Forest, AdaBoost, Support Vector Machines (SVM), Introduction to Neural Networks and Deep Learning, Perceptron Model, Activation Functions, Gradient Descent, Regularization: L1, L2, Dropout Techniques

**Module V:**

**Model Deployment and Applications:** Model Selection and Hyperparameter Tuning (Grid Search, Random Search), Cross-validation Techniques, Feature Engineering and Feature Scaling, Model Deployment (Saving, Loading, and Serving ML Models), Ethical Issues in Machine Learning: Bias, Fairness, Privacy, Explainability, Recent Trends and Case Studies

**Textbooks**

1. **Ethem Alpaydin**, *Introduction to Machine Learning*, MIT Press, 4th Edition, 2020.
2. **Tom M. Mitchell**, *Machine Learning*, McGraw-Hill Education, 1997.
3. **Christopher M. Bishop**, *Pattern Recognition and Machine Learning*, Springer, 2006.

**Reference Books**

1. **Kevin P. Murphy**, *Machine Learning: A Probabilistic Perspective*, MIT Press, 2012.
2. **Andreas C. Müller & Sarah Guido**, *Introduction to Machine Learning with Python*, O'Reilly Media, 2016.
3. **Ian Goodfellow, Yoshua Bengio, and Aaron Courville**, *Deep Learning*, MIT Press, 2016.
4. **Aurélien Géron**, *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, O'Reilly Media, 3rd Edition, 2023.

| Course Code | Course Title | | | | | | Core/ Elective |
|---|---|---|---|---|---|---|---|
| P25OE008EC | Real Time Operating System for Embedded Applications | | | | | | Open Elective |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Programming in C | 3 | - | - | - | 40 | 60 | 3 |

**Course Objectives**

The course aims to

- Introduce real-time systems and their design principles, focusing on performance measures, task scheduling, fault tolerance and real-time models.
- Explain µC/OS-II RTOS concepts including multitasking, scheduling, kernel structure and inter-task communication mechanisms.
- Familiarize students with µC/OS-II RTOS functions such as task, time, semaphore, and eventand memory management, along with comparisons to other popular RTOS platforms.
- Provide in-depth knowledge of Embedded Linux, its architecture, kernel, root file system, start-up sequence and porting applications from RTOS to Linux.
- Equip students with skills in Real-Time Linux development, including kernel building, debugging, driver development, board support packages and basic C programming in Linux.

**Course Outcomes**

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

- Analyse the architecture, performance measures, and scheduling algorithms in real-time systems.
- Implement multitasking and inter-task communication using µC/OS-II RTOS.
- Utilize µC/OS-II functions for efficient task, time, semaphore, and memory management in embedded applications.
- Configure and port applications to Embedded Linux by understanding its kernel architecture and start-up process.
- Develop and debug real-time applications on Linux, including kernel modules, embedded drivers, and board-level support.

**MODULE I**

**REAL TIME SYSTEMS :** Introduction- Issues in real time computing- Structure of a real time system- Task classes- Performance measures for real time systems- Task assignment and scheduling algorithms - Mode changes- Fault tolerant scheduling - Real Time Models.

**MODULE II**

**µC/OS- II RTOS CONCEPTS:**Foreground/Background process- Resources - Tasks - Multitasking -Priorities - Schedulers -Kernel - Exclusion - Inter task communication-Interrupts - Clock ticks - µC/OS- II Kernel structure - µC/OS- II Initialisation - Starting µC/OS- II.

**MODULE III**

**µC/OS- II RTOS FUNCTIONS :**Task Management - Time management - Semaphore management - Mutual exclusion semaphore - Event Management –Message management - Memory management - Porting µC/OS- II – Comparison and Study of Various RTOS like QNX- VX Works- PSOS.

**MODULE IV**

**EMBEDDED LINUX :** Features - Embedded Linux Distributions - Architecture of Embedded Linux - Linux Kernel Architecture – User Space -Root File System - Linux Start-Up Sequence - GNU Cross Platform Tool chain - Porting Traditional RTOS Applications to Linux.

**MODULE V**

**REAL-TIME LINUX:** Linux and Real-Time - Real-Time Programming in Linux - Hard Real-Time Linux - Building and Debugging - Building the Kernel- Integrated Development Environment - Kernel Debuggers - Embedded Drivers - Board support packages - Introduction to C linux.

***Suggested Readings:***

1. Krishna C.M., Kang G. Shin, "Real Time Systems", Tata McGraw-Hill Edition, 2010.
2. 2 Philip A.Laplante, "Real Time Systems Design and Analysis-An Engineers Handbook", II EditionIEEE Press, IEEE ComputerSociety Press, 2001
3. Jean J Labrosse, "MicroC/OS-II The Real Time Kernel" II Edition,CMP Books, 2002.
4. P. Raghavan,Amol Lad, SriramNeelakandan, "Embedded LinuxSystem Design and Development", Auerbach Publications, Taylor& Francis Group, 2006.
5. Christopher Hallinan, "Embedded Linux Primer, A Practical, Real-World Approach", II Edition Pearson Education, Inc., 2011.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25AD001HS** | **English for Research Paper Writing** | | | | | | **Audit** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives:**

- To learn the Features of Academic Writing
- To write Essays, Reports, Reviews, Abstracts and Proposals
- To demonstrate Academic Writing Skills
- To analyse the Research Process
- To apply appropriate structure to a Research Document

**Course Outcomes:**

At the end of the course, the student should be able to

- Learn the Features, Tone, Style, and Ethics pertaining to Academic Writing
- write Essays, Reports, Reviews, Abstracts and Proposals
- demonstrate Academic Writing Skills such as Paraphrasing, Summarizing, Quoting, Rewriting and Expansion
- Analyse the Research Process from Selection of Topic, Formulation of Hypothesis, Collection, Analysis, Interpretation and Presentation of Data
- apply appropriate structure to a Research Document, such as selection of Title, writing the Abstract, Introduction, Literature Survey, Methodology, Discussion,
- Findings/Results, Conclusion and Documenting Sources (IEEE style)

**MODULE I: Features of Academic Writing**

**Language**: Clear, Correct, Concise, Inclusive; **Tone**: Formal, Objective, Cautious; **Style**: Appropriate, Accurate, Organized; **Ethics**: Honesty, Integrity, Responsibility, Accountability

**MODULE II: Kinds of Academic Writing**

Essays, Reports, Reviews, Abstracts, Proposals

**MODULE III: Academic Writing Skills**

Paraphrasing; Summarizing; Quoting; Rewriting; Expansion

**MODULE IV**: **Research Process**

Selection of Topic, Formulation of Hypothesis, Collection of Data, Analysis of Data, Interpretation of Data, Presentation of Data

**MODULE V: Structure of a Research Document**

Title, Abstract, Introduction, Literature Survey, Methodology, Discussion, Findings/Results, Conclusion, Documenting Sources (IEEE style)

***Suggested Readings:***


1. Bailey, S. (2014). *Academic writing: A handbook for international students*. Routledge.
2. Gillett, A., Hammond, A., &Martala, M. (2009). *Inside track: Successful academic writing*. Essex:Pearson Education Limited.
3. Griffin, G. (2006). *Research methods for English studies*. Edinburgh:Edinburgh UniversityPress.
4. ***Silyn-Roberts, Heather. (2013). Writing for Science and Engineering: Papers, Presentations and Reports (2nd ed.).Elsevier.***
5. Lipson, Charles (2011). *Cite right: A quick guide to citation styles; MLA,APA, Chicago, the sciences, professions, and more* (2nd ed.). Chicago [u.a.]: University of Chicago Press.
6. ***Mark Cholij*** 2007 Towards Academic English; Developing Effective Writing Skills Cambridge University Press India Ltd., New Delhi India

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25AD002CE** | **Disaster Management** | | | | | | **Audit** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **30** | **70** | **-** |

**Course Objectives**

- To impart knowledge in students about the nature, causes, consequences and mitigation measures of the various natural disasters
- To enable the students to understand risks, vulnerabilities and human errors associated with human induced disasters
- To enable the students to understand and assimilate the impacts of any disaster on the affected area depending on its position/ location, environmental conditions, demographic,etc.

**Course Outcomes**

At the end of this course, students will be able to**:**

- Learn to demonstrate a critical understanding of key concepts in disaster risk reduction
- and humanitarian response.
- Critically evaluate disaster risk reduction and humanitarian response policy and Practice from multiple perspectives.
- Develop an understanding of standards of humanitarian response and practical relevance in specific types of disasters and conflict situations.
- Critically understand the strengths and weaknesses of disaster management approaches, planning and programming in different countries, particularly their home country or the countries they work in**.**

**MODULE-I**

**Introduction:** Disaster: Definition, Factors and Significance; Difference between Hazard and Disaster; Natural and Manmade Disasters: Difference, Nature, Types and Magnitude.

**MODULE-II**

**Repercussions of Disasters and Hazards**: Economic Damage, Loss of Human and Animal Life, Destruction of Ecosystem.

**Natural Disasters:** Earthquakes, Volcanisms, Cyclones, Tsunamis, Floods, Droughts and Famines, Landslides and Avalanches, Man-made disaster: Nuclear Reactor Meltdown, Industrial Accidents, Oil Slicks and Spills, Outbreaks of Disease and Epidemics, War and Conflicts.

**MODULE-III**

**Disasters Prone Areas in India:** Study of Seismic Zones; Areas Prone to Floods and Droughts, Landslides and Avalanches; Areas Prone to Cyclonic and Coastal Hazards with Special Reference to Tsunami; Post-Disaster Diseases and Epidemics

**MODULE-IV**

**Disaster Preparedness:** Monitoring of Phenomena Triggering a Disaster or Hazard; Evaluation of Risk: Application of Remote Sensing, Data from Meteorological and Other Agencies, Media Reports: Governmental and Community Preparedness.

**MODULE-V**

**Disaster Risk:** Concept and Elements, Disaster Risk Reduction, Global and National Disaster Risk Situation. Techniques of Risk Assessment, Global Co-Operation in Risk Assessment and Warning, People's Participation in Risk Assessment. Strategies for Survival. Meaning, Concept and Strategies of Disaster Mitigation, Emerging Trends in Mitigation. Structural Mitigation and Non-Structural Mitigation, Programs of Disaster Mitigation in India.

***Suggested Readings:***

1. R. Nishith, Singh AK, "Disaster Management in India: Perspectives, issues and strategies", New Royal Book Company.
2. Sahni, Pardeep (Eds.), "Disaster Mitigation Experiences and Reflections", PHI, NewDelhi.
3. Goel S. L., "Disaster Administration and Management Text and Case Studies", Deep & Deep Publication Pvt. Ltd., New Delhi.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25AD003HS** | **Sanskrit for Technical Knowledge** | | | | | | **Audit** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

- To get a working knowledge in illustrious Sanskrit, the scientific language in the world
- To make the novice Learn the Sanskrit to develop the logic in mathematics, science & other subjects
- To explore the huge knowledge from ancient Indian literature

**Course Outcomes**

At the end of this course, students will be able to**:**

- Develop passion towards Sanskrit language
- Decipher the latent engineering principles from Sanskrit literature
- Correlates the technological concepts with the ancient Sanskrit history.
- Develop knowledge for the technological progress
- Explore the avenue for research in engineering with aid of Sanskrit

**MODULE-I**

**Introduction to Sanskrit Language:** Sanskrit Alphabets-vowels-consonants- significance of Amarakosa-parts of Speech-Morphology-creation of new words-significance of synonyms-sandhi-samasa-sutras-active and passive Voice-Past/Present/Future Tense-Syntax-Simple Sentences (elementary treatment only)

**MODULE-II**

**Role of Sanskrit in Basic Sciences:** Brahmagupthas lemmas (second degree indeterminate equations), sum of squares of n-terms of AP- sulba, sutram or baudhayana theorem (origination of Pythagoras theorem)-value of pie-Madhava's sine and cosine theory (origination of Taylor's series).

The measurement system-time-mass-length-temp, Matter elasticity-optics-speed of light (origination of Michaelson and Morley theory).

**MODULE-III**

**Role of Sanskrit in Engineering-I (Civil, Mechanical, Electrical and Electronics Engineering):**

Building construction-soil testing-mortar-town planning-Machine definition-crucible-furnace-air blower-Generation of electricity in a cell-magnetism-Solar system-Sun: The source of energy, the earth-Pingalachandasutram (origination of digital logic system)

**MODULE-IV**

**Role of Sanskrit in Engineering-II (Computer Science Engineering & Information Technology):** Computer languages and the Sanskrit languages-computer command words and the vedic command words-analogy of pramana in memamsa with operators in computer language-sanskrit analogy of physical sequence and logical sequence, programming.

**MODULE - V**

**Role of Sanskrit in Engineering-III (Bio-technology and Chemical Engineering):** Classification of plants- plants, the living-plants have senses-classification of living creatures, Chemical laboratory location and layout- equipment-distillation vessel-kosthiyanthram

***Suggested Readings:***

1. M Krishnamachariar, History of Classical Sanskrit Literature, TTD Press,1937.
2. M.R. Kale, A Higher Sanskrit Grammar: For the Use of School and College Students, MotilalBanarsidass Publishers, 2015.
3. KapailKapoor, Language, Linguistics and Literature: The Indian Perspective, ISBN- 10: 8171880649,1994.
4. Pride of India, SamskritaBharati Publisher, ISBN: 81-87276 27-4,2007.
5. Shri Rama Verma, Vedas the source of ultimate science, Nag publishers,2005.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25AD004HS** | **Value Education** | | | | | | **Audit** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

- Understand the need and importance of Values for self-development and for National development.
- Imbibe good human values and Morals
- Cultivate individual and National character.

**Course Outcomes**

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

- Gain necessary Knowledge for self-development.
- Learn the importance of Human values and their application in day-to-day professional life.
- Appreciate the need and importance of interpersonal skills for successful career and social life
- Emphasize the role of personal and social responsibility of an individual for all-round growth.
- Develop a perspective based on spiritual outlook and respect women, other religious practices, equality, non-violence and universal brotherhood.

**MODULE-I**

**Human Values, Ethics and Morals:** Concept of Values, Indian concept of humanism, human values; Values for self-development, Social values, individual attitudes; Work ethics, moral and non- moral behaviour, standards and principles based on religion, culture and tradition.

**MODULE-II**

**Value Cultivation, and Self-management:** Need and Importance of cultivation of values such as Sense-of Duty, Devotion to work, Self-reliance, Confidence, Concentration, Integrity & discipline, and Truthfulness.

**MODULE-III**

**Spiritual outlook and social values:** Personality and Behavior, Scientific attitude and Spiritual (soul) outlook; Cultivation of Social Values Such as Positive Thinking, Punctuality, Love & Kindness, avoiding fault finding in others, Reduction of anger, forgiveness, Dignity of labour, True friendship, Universal brotherhood and religious tolerance.

**MODULE-IV**

**Values in Holy Books:** Self-management and Good health; internal & external cleanliness, Holy books versus Blind faith, Character and Competence, Equality, Nonviolence, Humility, Role of Women.

**MODULE - V**

**Dharma, Karma and Guna:** Concept of soul; Science of Reincarnation, Character and Conduct, Concept of Dharma; Cause and Effect based Karma Theory; The qualities of Devine and Devilish; Satwic, Rajasic and Tamasic gunas.

***Suggested Readingss:***

1. Chakroborty,S.K.,Values&EthicsfororganizationsTheoryandpractice|,OxfordUniversityPress, New Delhi, 1998.
2. Jaya Dayal Goyandaka, Srimad Bhagavad Gita with Sanskrit Text, Word Meaning and Prose Meaning|, GitaPress,Gorakhpur,2017.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25AD005HS** | **Constitution of India and Fundamental Rights** | | | | | | **Audit** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

- Understand the premises informing the twin themes of liberty and freedom from a civil rights perspective and to address the growth of Indian opinion regarding modern Indian intellectuals' constitutional role and entitlement to civil and economic rights as well as the emergence of nationhood in the early years of Indian nationalism.

**Course Outcomes**

At the end of this course, students will be able to**:**

- Discuss the growth of the demand for civil rights in India for the bulk of Indians before the arrival of Gandhi in Indian politics.
- Discuss the intellectual origins of the framework of argument that informed the conceptualization of social reforms leading to revolution in India.
- Discuss the circumstances surrounding the foundation of the Congress Socialist Party [CSP] under the leadership of Jawaharlal Nehru and the eventual failure of the proposal of direct elections through adult suffrage in the Indian Constitution.
- Discuss the passage of the Hindu Code Bill of1956.

**MODULE-I**

**History of Making of the Indian Constitution**: History, Drafting Committee, (Composition & Working) Philosophy of the Indian Constitution: Preamble, Salient Features.

**MODULE-II**

**Contours of Constitutional Rights & Duties**: Fundamental Rights, Right to Equality, Right to Freedom, Right against Exploitation, Right to Freedom of Religion, Cultural and Educational Rights, Right to Constitutional Remedies, Directive Principles of State Policy, Fundamental Duties.

**MODULE-III**

**Organs of Governance**: Parliament, Composition, Qualifications and Disqualifications, Powers and Functions, Executive, President, Governor, Council of Ministers, Judiciary, Appointment and Transfer of Judges, Qualifications. Powers and Functions.

**MODULE-IV**

**Local Administration**: District's Administration head: Role and Importance, Municipalities: Introduction, Mayor and role of Elected Representative CEO of Municipal Corporation, Panchayat raj: Introduction, PRI: Zilla Panchayat, Elected officials and their roles, CEO Zilla Panchayat: Position and role. Block level: Organizational Hierarchy (Different departments), Village level: Role of Elected and Appointed officials, Importance of grass root democracy.

**MODULE - V**

**Election Commission**: Election Commission: Role and Functioning. Chief Election Commissioner and Election Commissioners. State Election Commission: Role and Functioning. Institute and Bodies for the welfare of SC/ST/OBC and women.

***Suggested Readings:***

1. The Constitution of India, 1950 (Bare Act), Government Publication.
2. Dr. S. N. Busi, Dr. B. R. Ambedkar framing of Indian Constitution, 1st Edition,2015.
3. M. P. Jain, Indian Constitution Law, 7th Edn., Lexis Nexis,2014.
4. D.D. Basu, Introduction to the Constitution of India, Lexis Nexis,2015.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25AD006HS** | **Pedagogy Studies** | | | | | | **Audit** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

- To present the basic concepts of design and policies of pedagogy studies.
- To provide understanding of the abilities and dispositions with regard to teaching techniques, curriculum design and assessment practices.
- To familiarize various theories of learning and their connection to teaching practice.
- To create awareness about the practices followed by DFID, other agencies and other researchers.
- To provide understanding of critical evidence gaps that guides the professional development

**Course Outcomes**

At the end of this course, students will be able to**:**

- Illustrate the pedagogical practices followed by teachers in developing countries both in formal and informal classrooms.
- Examine the effectiveness of pedagogical practices.
- Understand the concept, characteristics and types of educational research and perspectives of research.
- Describe the role of classroom practices, curriculum and barriers to learning.
- Understand Research gaps and learn the future directions.

**MODULE-I**

**Introduction and Methodology:** Aims and rationale, Policy background, Conceptual framework and terminology - Theories of learning, Curriculum, Teacher education - Conceptual framework, Research questions, Overview of methodology and searching.

**MODULE-II**

**Thematic Overview:** Pedagogical practices followed by teachers in formal and informal classrooms in developing countries - Curriculum, Teacher education

**MODULE-III**

**Evidence on the Effectiveness of Pedagogical Practices:** Methodology for the in-depth stage: quality assessment of included studies - How can teacher education (curriculum and Practicum) and the school curriculum and guidance material best support effective pedagogy? - Theory of change - Strength and nature of the body of evidence for effective pedagogical practices - Pedagogic theory and pedagogical approaches – Teachers attitudes and beliefs and pedagogic strategies.

**MODULE-IV**

**Professional Development:** alignment with classroom practices and follow up support - Support from the head teacher and the community – Curriculum and assessment - Barriers to learning: Limited resources and large class sizes.

**MODULE - V**

**Research Gaps and Future Directions:** Research design – Contexts – Pedagogy - Teacher education - Curriculum and assessment – Dissemination and research impact.

***Suggested Readings:***


1. Ackers J, Hardman F, Classroom Interaction in Kenyan Primary Schools, Compare‖,31(2):245–261,2001.
2. Agarwal M, Curricular Reform in Schools: The importance of evaluation, Journal of Curriculum Studies, 36 (3): 361 – 379,2004.
3. Akyeampong K, Teacher Training in Ghana – does it count? Multisite teacher education research project (MUSTER), Country Report 1. London: DFID,2003.
4. Akyeampong K, Lussier K, Pryor J, Westbrook J, Improving teaching and learning of Basic Maths and Reading in Africa: Does teacher Preparation count? International Journal Educational Development, 33 (3): 272- 282,2013.
5. Alexander R J, Culture and Pedagogy: International Comparisons in Primary Education, Oxford and Boston: Blackwell,2001.
6. Chavan M, Read India: A mass scale, rapid, learning to read campaign,2003.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25AD007HS** | **Stress Management by Yoga** | | | | | | **Audit** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **70** | **-** |

**Course Objectives**

The Course will introduce the students to

- Creating awareness about different types of stress and the role of yoga in the management of stress.
- Promotion of positive health and overall wellbeing (Physical, mental, emotional, social and spiritual).
- Prevention of stress related health problems by yoga practice.

**Course Outcomes**

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

- Understand yoga and its benefits.
- Enhance Physical strength and flexibility.
- Learn to relax and focus.
- Relieve physical and mental tension through asanas.
- Improve work performance and efficiency.

**MODULE - I**

**Meaning and Definition of Yoga -** Historical perspective of Yoga - Principles of Astanga Yoga by Patanjali.

**MODULE - II**

**Meaning and Definition of Stress** - Types of stress - Eustress and Distress. Anticipatory Anxiety and Intense Anxiety and depression. Meaning of Management- Stress Management.

**MODULE - III**

**Concept of Stress According to Yoga** - Stress assessment methods - Role of Asana, Pranayama and Meditation in the management of stress

**MODULE - IV**

**Asanas**- (5 Asanas in each posture) - Warm up - Standing Asanas - Sitting Asanas - Prone Asanas - Supine asanas - Surya Namaskar.

**MODULE - V**

**Pranayama-** Anulom and Vilom Pranayama - Nadishudhi Pranayama - Kapalabhati Pranayama - Bhramari Pranayama - Nadanusandhana Pranayama.

**Meditation Techniques:** Om Meditation - Cyclic meditation: Instant Relaxation technique (QRT), Quick Relaxation Technique (QRT), Deep Relaxation Technique (DRT)

***Suggested Readingss:***

1. "Yogic Asanas for Group Training - Part-I", Janardhan Swami Yoga bhyasi Mandal, Nagpur.
2. Swami Vivekananda, "Rajayoga or Conquering the Internal Nature", Advaita Ashrama (Publication Department), Kolkata.
3. Nagendra H.R and Nagaratna R, "Yoga Perspective in Stress Management", Swami Vivekananda Yoga Prakashan, Bangalore.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25AD008HS** | **Personality Development Through Life Enlightenment Skills** | | | | | | **Audit** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | **2** | **-** | **-** | **-** | **40** | **60** | **-** |

**Course Objectives**

- To learn to achieve the highest goal happily
- To become a person with stable mind, pleasing personality and determination
- To awaken wisdom in students

**Course Outcomes**

At the end of this course, students will be able to**:**

- Develop their personality and achieve their highest goal of life.
- Lead the nation and mankind to peace and prosperity.
- Practice emotional self-regulation.
- Develop a positive approach to work and duties.
- Develop a versatile personality.

**MODULE - I**

**Neeti satakam – Holistic Development of Personality** - Verses 19, 20, 21, 22 (Wisdom) - Verses 29, 31, 32 (Pride and Heroism) - Verses 26,28,63,65 (Virtue)

**MODULE - II**

**Neeti satakam – Holistic Development of Personality (cont'd)** - Verses 52, 53, 59 (don'ts) - Verses 71,73,75& 78 (do's) - Approach to day to day works and duties.

**MODULE - III**

**Introduction to Bhagavadgeetha for Personality Development – Shrimad Bhagavadgeetha**: Chapter 2 – Verses 41, 47, 48 - Chapter 3 – Verses 13,21,27,35 - Chapter 6 – Verses 5,13,17,23,35 - Chapter 18 – Verses 45, 46, 48 Chapter – 6: Verses 5, 13, 17, 23, 35; Chapter – 18: Verses 45, 46, 48

**MODULE - IV**

**Statements of Basic Knowledge – Shrimad Bhagavadgeetha**: Chapter 2- Verses 56, 62,68 - Chapter 12 – Verses 13, 14, 15, 16, 17, 18 - Personality of Role model from Shrimad BhagawatGeeta.

**MODULE - V**

**Role of Bhagavadgeetha in the Present Scenario -** Chapter 2 – Verses 17 - Chapter 3 – Verses 36, 37, 42 - Chapter 4 – Verses 18, 38, 39 - Chapter 18 – Verses 37, 38, 63.

***Suggested Readingss:***

1. Srimad Bhagavad Gita, Swami Swarupananda Advaita Ashram (Publication Department),Kolkata
2. Bhartrihari's Three Satakam (Niti-sringar-vairagya), P.Gopinath, Rashtriya Sanskrit Sansthanam, NewDelhi

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC801ME** | **CAD and Additive Manufacturing lab.** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| Basic drafting and modeling | **-** | **-** | **-** | **2** | **25** | **50** | **1** |

**Course Objectives**

- To impart practical skills in CAD modeling and additive manufacturing, enabling students to design, assemble, and fabricate mechanical components using industry-standard tools.

**Course Outcomes**

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

- Execute surface modeling
- Execute sheet metal modeling
- Execute solid modeling
- Understand the concepts of production drawing and execute it using CAD software
- Prepare STL files through pre-processing and construct basic 3D models using modeling software.
- Analyze the role of 3D printing in modern manufacturing and design and produce 3D printed components

**List of Exercises:**

**A. CAD Lab**

1. Introduction to solid modeling various commands
2. Creation of various mechanical parts using advanced features.
3. Assembling of part models using constraints, part modifications, adding another assembly features – display
4. Understand the various commands related to surface modeling
5. Understand the various commands related to sheet metal modeling and create sheet metal parts.
6. Creation of engineering drawing details such as dimensioning, sectional views.

**B. Additive Manufacturing Experiments:**

1. Fundamentals of additive manufacturing: Principles, types, and workflow of additive manufacturing, study the working and parts of a 3D printer.
2. 3D Modeling using CAD software (SOLIDWORKS): Basics of CAD tools and create simple 3D models.
3. Slicing and print preparation using slicing software like CURA: Introduction, import models, configure print settings, and generate G-code.
4. 3D Printing Practice: Operate a 3D printer to print basic parts, perform post-processing and evaluate print quality.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC802ME** | **CAM and Automation Lab** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **-** | **-** | **-** | **2** | **25** | **50** | **1** |

**Course Objectives:**

The objectives of this course are

- To develop practical skills in CNC machining, CAM simulation, and PLC programming for integrated automation and smart manufacturing systems.

**Course Outcomes**

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

- Carry out CNC programming on Lathe operations
- Carry out CNC programming on Milling operations
- Execute the PLC programming for various applications

**List of Exercises:**

Understanding of CNC Machines and CNC Programming and Creation of

1. Facing, turning, step turning, taper turning, contouring etc. on CNC lathe machine.
2. Pocketing and contouring on CNC milling machine.
3. Simulation and development of NC code using any CAM software.
4. Programming for integration of various CNC machines, robots and material handling systems.
5. Implementation of Logic gates (AND, OR, XOR, NAND) using PLC
6. Implementation of Stepper motor control using PLC.
7. PLC program to Latch and Unlatch output with time delay
8. PLC program to drive motors simultaneously with interlocking

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC803ME** | **Drones and Robotics Lab** | | | | | | Core |
| Prerequisite | Contact hours per week | | | | CIE | SEE | Credits |
| Mathematics, Physics and Programming | L | T | D | P | | | |
| | **-** | **-** | **-** | **2** | **25** | **50** | **1** |

**Course Objectives:**

The objectives of this course are

- To impart essential knowledge and hands-on skills in drone and robotics systems, covering assembly, control, navigation, automation, and troubleshooting for real-world applications.

**Course Outcomes:**

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

- Identify and assemble core components of drones and robotic systems, including control and sensing units.
- Operate drones in manual and GPS-assisted modes and execute mission planning using waypoint navigation.
- Develop basic autonomous robotic systems such as line followers and obstacle-avoiding bots using sensors.
- Program robotic arms and payload mechanisms to perform task-oriented operations with precision.
- Diagnoses and troubleshoot issues related to drone/robot stability, control, and hardware integration.

**List of Experiments: Drones Lab**

1. Drone Components Identification and Assembly
2. Drone Flight Control – Manual Mode
3. GPS Hold and Return to Home (RTH) Testing
4. Autonomous Mission Planning (Waypoints)
5. Payload Dropping Mechanism

**List of Experiments: Robotics Lab**

6. Introduction to anatomy of the Robot
7. Pick and Place Operation using Robotic Arm
8. Line Following Robot
9. Obstacle Avoidance Robot
10. Programming Robotic Arm for Colour Sorting

**Additional Experiments for Practice**

1. Drone Stability under Wind Disturbance
2. Debugging and Repair of a Drone

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC804ME** | **Computational Lab** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **-** | **-** | **-** | **2** | **25** | **50** | **1** |

**Course Objectives**

- To develop foundational and practical skills in finite element analysis, including matrix formulation, structural stress evaluation, and simulation of mechanical components using FEA software.

**Course Outcomes**

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

- Determine the stiffness and loading matrices for various applications
- Carry out structural analysis of various components
- Determine the bending and deflection in components

**List of Exercises:**

1. To determine the stiffness matrix and loading matrices in Beams
2. To determine the B matrix, loading matrices in plane
3. Introduction to Finite Element Analysis Software.
4. Static analysis of a corner bracket.
5. Statically indeterminate reaction force analysis. (Truss/bar element-basic)
6. Determination of Beam stresses and Deflection. (Cantilever and Simply supported beams)
7. Bending of a circular plate using axisymmetric shell element
8. Stress analysis using plane stress and plane strain.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PC806ME** | **Mini Project with Seminar** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **-** | **-** | **-** | **4** | **50** | **-** | **1** |

**Course Outcomes**

At the end of this course, students will be able to**:**

- Formulate a specific problem and give solution
- Develop model/models either theoretical/practical/numerical form
- Solve, interpret/correlate the results and discussions
- Conclude the results obtained
- Write the documentation in standard format

**Guidelines:**

- As part of the curriculum in the II- semester of the programme each student shall do a mini project, generally comprising about three to four weeks of prior reading, twelve weeks of active research, and finally a presentation of their work for assessment.
- Each student will be allotted to a faculty supervisor for mentoring.
- Mini projects should present students with an accessible challenge on which to demonstrate competence in research techniques, plus the opportunity to contribute something more original.
- Mini projects shall have inter-disciplinary/ industry relevance.
- The students can select a mathematical modelling based/Experimental investigations or Numerical modelling
- Alltheinvestigationsshouldbeclearlystatedanddocumentedwiththereasons/explanations.
- The mini-project shall contain a clear statement of the research objectives, background of work, literature review, techniques used, prospective deliverables, and detailed discussion on results, conclusions and reference

**Departmental committee: Supervisor and a minimum of two faculty members**

| **Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 50** | | |
|---|---|---|
| **Evaluation by** | **Max. Marks** | **Evaluation Criteria / Parameter** |
| Supervisor | 20 | Progress and Review |
| | 05 | Report |
| Departmental Committee | 05 | Relevance of the Topic |
| | 05 | PPT Preparation |
| | 05 | Presentation |
| | 05 | Question and Answers |
| | 05 | Report Preparation |

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PW801ME** | **Major Project Phase – I** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| **-** | **-** | **-** | **-** | **20** | **100** | **-** | **10** |

**Course Outcomes**

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

- Exposed to self-learning various topics.
- Learn to survey the literature such as books, journals and contact resource persons for the selected topic of research.
- Learn to write technical reports.
- Develop oral and written communication skills to present.
- Defend their work in front of technically qualified audience

**Guidelines:**

- The Project work will preferably be a problem with research potential and should involve scientific research, design, generation/collection and analysis of data, determining solution and must preferably bring out the individual contribution.
- Seminar should be based on the area in which the candidate has undertaken the dissertation work.
- The CIE shall include reviews and the preparation of report consisting of a detailed problem statement and a literature review.
- The preliminary results (if available) of the problem may also be discussed in the report.
- The work has to be presented in front of the committee consists of Chairperson-BoS, and Head, Supervisor & Project coordinator from the respective Department of the Institute.
- The candidate has to be in regular contact with his supervisor and the topic of dissertation must be mutually decided by the guide and student.

| **Guidelines for awarding marks in CIE (Continuous Internal Evaluation): Max. Marks: 100** | | |
|---|---|---|
| **Evaluation by** | **Max. Marks** | **Evaluation Criteria / Parameter** |
| Supervisor | 30 | Project Status / Review(s) |
| | 20 | Report |
| Departmental Committee (Chairperson BoS, and Head, Supervisor & Project coordinator from the respective department of the institution) | 10 | Relevance of the Topic |
| | 10 | PPT Preparation |
| | 10 | Presentation |
| | 10 | Question and Answers |
| | 10 | Report Preparation |

**Note:** The Supervisor has to assess the progress of the student regularly.

| Course Code | Course Title | | | | | | Core/Elective |
|---|---|---|---|---|---|---|---|
| **P25PW802ME** | **Major Project Phase – II (Dissertation)** | | | | | | **Core** |
| Prerequisite | Contact Hours per Week | | | | CIE | SEE | Credits |
| | L | T | D | P | | | |
| - | - | - | - | **32** | - | **200** | **16** |

**Course Outcomes**

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

- Use different experimental techniques and will be able to use different software/computational /analytical tools.
- Design and develop an experimental set up/ equipment/test rig.
- Conduct tests on existing set ups/equipment and draw logical conclusions from the results after analysing them.
- Either work in a research environment or in an industrial environment.
- Conversant with technical report writing and will be able to present and convince their topic of study to the engineering community

**Guidelines:**

- It is a continuation of Major Project Phase – I started in semester -III.
- The student has to submit the report in prescribed format and also present a seminar.
- The dissertation should be presented in standard format as provided by the department.
- The candidate has to prepare a detailed project report consisting of introduction of the problem, problem statement, literature review, objectives of the work, methodology (experimental set up or numerical details as the case may be) of solution and results and discussion.
- The report must bring out the conclusions of the work and future scope for the study. The work has to be presented in front of the examiners panel consisting of an approved external examiner and Chairperson BoS, & Head, and Supervisor from the Institute.
- The candidate has to be in regular contact with his/her Supervisor / Co-Supervisor

| **Guidelines for awarding marks in SEE (Semester End Examination): Max. Marks: 200** | | |
|---|---|---|
| **Evaluation by** | **Max. Marks** | **Evaluation Criteria / Parameter** |
| Supervisor | 10 | Regularity and Punctuality |
| | 10 | Work Progress |
| | 30 | Quality of the work which may lead to publications |
| | 10 | Analytical / Programming / Experimental Skills Preparation |
| | 10 | Report preparation in a standard format |
| External Examiner and Chairperson, BoS& Head of the department (All together) | 20 | Power Point Presentation |
| | 60 | Quality of thesis and evaluation |
| | 30 | Innovations, application to society and Scope for future study |
| | 20 | Viva-Voce |