KIT – Kalaignarkarunanidhi Institute of Technology

(An Autonomous Institution)

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' GRADE & NBA (AERO, CSE, ECE, EEE, MECH & MBA)
An ISO 9001 : 2015 Certified Institution
Coimbatore – 641 402.

REGULATIONS, CURRICULUM & SYLLABI – 2023

(For the students admitted during 2023 - 2024 and onwards)

I to IV Semester

Master of Engineering in Engineering Design

Department of Mechanical Engineering

Vision and Mission of the Department

Vision

◎	To promote the department as renowned innovation center for enriching the society and nurture the students as advanced potent and paradigm mechanical engineering professionals.

Mission

◎	To provide quality education in the domain of Mechanical Engineering in a conductive environment for enabling the students to face challenging career in ethical manner.
◎	To inculcate technical knowledge to create a strong foundation for generating full-fledged professionals in the field of Mechanical Engineering.
◎	To foster the students with Entrepreneurship training through EDC, leadership qualities and communication skills to meet the global demands

Program Educational Objectives (PEO's)

PEO 1	Graduates will have successful professional career in Mechanical Engineering or related disciplines.
PEO 2	Graduates will formulate, analyze and solve real – world problems in Mechanical engineering to meet global challenges.
PEO 3	Graduates will have awareness and commitment to lifelong learning and professional ethics in their professional practice.

Programme Outcomes (PO's)

Students graduating from Mechanical Engineering should be able to:

PO 1	**Engineering knowledge :** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
PO 2	**Problem analysis :** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
PO 3	**Design / development of solutions :** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmentalconsiderations.

PO 4	**Conduct investigations of complex problems :** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
PO 5	**Modern tool usage :** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
PO 6	**The engineer and society :** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
PO 7	**Environment and sustainability :** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
PO 8	**Ethics :** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
PO 9	**Individual and team work :** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
PO 10	**Communication :** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
PO 11	**Project management and finance :** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
PO 12	**Life-long learning :** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcome (PSO's)	
Graduates of a Mechanical Engineering Programme should be able to	
PSO 1	Apply the mechanical engineering principles to solve engineering problems utilizing advanced technology in the domain of design, thermal, fluid sciences and robotics.
PSO 2	Take part as an entrepreneur or professional in industries by applying manufacturing and management practices for the advancement of society and self.

Approved by BoS Chairman

PG Regulations

1. SHORT TITLE AND COMMENCEMENT

- These Regulations shall be called the "KIT Kalaignarkaraunanidhi Institute of Technology, Coimbatore, Regulations for the Award of M.E. / M.Tech. / M.B.A / M.C.A., Degree".
- They have been evolved, drafted and implemented after deliberations in and approvals from UGC, Anna University and Academic Council of the Institute, and are subject to change/modifications from time to time; (major modifications at a frequency of TWO years in synchronization with the curriculum structure revision and minor changes as and when applicable).
- The latest / first version shall be applicable for the students enrolling for M.E. / M.Tech. / M.B.A / M.C.A., degree programs at this Institute from Academic year 2023 - 2024 onwards.

2. PREAMBLE

The regulations prescribed herein have been made by KIT, an autonomous institution, approved by AICTE,New Delhi and affiliated to the Anna University, Chennai, to facilitate the smooth and orderly conduct of its academic programmes and activities at the M.E. / M.Tech. / M.B.A / M.C.A.,level. It is expected that the regulations will enable the students to take advantage of the various academic opportunities at the Institute and prepare themselves to face the challenges in their professional careers ahead. It may be noted that :

a. The provision made herein shall be applicable to all the M.E. / M.Tech. / M.B.A / M.C.A., programmes offered at the institute, at present;

b. They shall also be applicable to all the new M.E. / M.Tech. / M.B.A / M.C.A., programmes which may be started at the Institute in the future;

c. Academic and non-academic requirements prescribed by the Academic Council have to be fulfilled by a student for eligibility towards award of M.E. / M.B.A / M.C.A., Degree.

3. PRELIMINARY DEFINITIONS AND NOMENCLATURE

In these Regulations, unless the context otherwise requires :

Sl.No.	Name	Definition
1.	**Programme**	Refers to Degree Programme that is M.E. / M.Tech. / M.B.A / M.C.A., Degree Programme.
2.	**Discipline**	Refers to branch or specialization of M.E. / M.Tech. / M.B.A / M.C.A., Degree Programme, like Computer Science and Engineering, Mechanical Engineering etc.,
3.	**Course**	Refers to a theory or practical subject that is normally studied in a semester, like Computer Applications and Design, Machine learning Techniques, Marketing management, etc.,
4.	**Principal / Head of the Institution**	Refers to the authority of the institution who is responsible for all academic activities, for the implementation of relevant rules and regulations.

5.	**Controller of Examinations (CoE)**	Refers to the authority of the college who is responsible for all activities of the Examinations.
6.	**Head of the Department (HoD)**	Refers to the Head of the Department concerned.
7.	**University**	Refers to Anna University, Chennai.
8.	**KIT**	Refers to KIT-Kalaignarkarunanidhi Institute of Technology, Coimbatore.
9.	**Curriculum**	Refers to the various components / courses studied in each programme that provide appropriate outcomes (knowledge, skill and behavior / attitude) in the chosen branch of study.
10.	**L - T - P - C**	Refers to **L**ecture, **T**utorial, **P**ractical and **C**redits respectively.
11.	**Programme Coordinator**	Refers to the coordinator of the programme concerned. He/she acts as interface between programme and key stakeholders, students, faculty and employer. He/She is responsible for planning the academic activities of the programme along with the course coordinator(s) and the HoD. He/She also prepares, evaluates and analyses the attainment of the programme outcomes along with Programme Advisory Committee.
12.	**Faculty Advisor**	The Faculty Advisor is responsible for providing general advice on the Academic matters, monitor the attendance and academic performance of the students and counsel them periodically. If necessary, the Faculty Advisor may also inform the parents about the progress / performance of the students concerned through HoD.
13.	**Course Coordinator**	Course Coordinator is responsible for teaching the course, evaluating and analysing the performance of the students. The students is also responsible for the assessment of the Course Outcomes / Program Outcomes / Program Specific Outcomes. They can also recommend to organize workshops / seminars / guest lectures / industrial visits to meet the Course Outcomes and Program Outcomes.
14.	**Class committee**	Class committee for each semester of a programme comprises of HoD, Programme Coordinator, Faculty Advisor, Course Coordinators (as applicable) and Student Representatives.

15.	**Academic Evaluation Committee (AEC)**	The committee includes Principal, CoE, HoD concerned (For details refer **Appendix V**)
16.	**Department Evaluation Committee (DEC)**	The committee included HoD (need basis), senior faculty member(s) of department from various levels, class advisor, Mentor of the students. (For details refer **Appendix V**)
17.	**CIA**	Refers to Continuous Internal Assessment.
18.	**ESE**	Refers to End Semester Examination.
19.	**CBCS**	Choice Based Credit System (CBCS) is a versatile and flexible option for each student to achieve their target number of credits by using their choice both in terms of pace and sequence of courses. The students are given the privilege to choose any course as an elective which they have not studied before.
20.	**GPA**	Refers to Grade Point Average
21.	**CGPA**	Refers to Cumulative Grade Point Average
22.	**CEC**	Refers to Career Enhancement Courses
23.	**PCC**	Refers to Professional Certificate Courses
24.	**VAC**	Refers to Value Added Cources

4. ADMISSION

4.1 Candidates seeking admission to M.E. / M.Tech. / M.B.A / M.C.A., Degree Programme :

Candidates for admission to the first semester of the Post-Graduate Degree Programme shall be required to have passed an appropriate Under-Graduate Degree Examination of Anna University or equivalent as specified under qualification for admission as per the Tamil Nadu Common Admission (TANCA) criteria. This is applicable for students admitted both under Single Window Counselling process and through the Management Quota.

Note : TANCA releases the updated criteria during the admissions every academic year. Admission shall be offered only to the candidates who possess the qualification prescribed against each programme.

Any other relevant qualification which is not prescribed against each programme shall be considered for equivalence by the committee constituted for the purpose. Admission to such degrees shall be offered only after obtaining equivalence to such degrees.

However, the University may decide to restrict admission in any particular year to candidates having a subset of qualifications prescribed at the time of admission.

Notwithstanding the qualifying examination the candidate might have passed, he/she shall have a minimum level of proficiency in the appropriate programme / courses as prescribed by the University from time to time.

4.2 Re - admission

Students, who have discontinued for reasons other than disciplinary action, may be readmitted as per guidelines given by DoTE, Government of Tamilnadu and Anna University. Department Evaluation Committee (DEC) shall study and recommend on the exception and addition of courses to be registered for, by the student concerned during re-admission. The details shall be forward to Academic Evaluation Committee (AEC) for approval and the committee's decision shall be final.

5. PROGRAMMES OFFERED

KIT offers 2 year (4 Semesters) M.E. / M.Tech. / M.B.A / M.C.A., Degree programme affiliated to Anna University, under Choice Based Credit System (CBCS) for students admitted from 2023 onwards in the following branches of Engineering and Technology as in Table 1.

Table: 1 List of M.E. / M.B.A / M.C.A., programmes offered

M.E., Applied Electronics
M.E., VLSI Design
M.E., Engineering Design
M.E., Computer Science and Engineering
M.E., Power Systems Engineering
M.B.A., Master of Business Administration
M.C.A., Master of Computer Application

6. ACADEMIC STRUCTURE OF PROGRAMMES

6.1 Medium of Instruction

The medium of instruction is English for all courses, examinations, seminar presentations and project / thesis / dissertation.

6.2 Categorization of Courses

Every Post Graduate Degree Programme will have a curriculum with syllabi consisting of theory and practical courses that shall be categorized as follows:

i. Foundation Courses (FC) may include Mathematics or other basic courses

ii. Professional Core (PC) courses include the core courses relevant to the chosen specialization/branch.

iii. Professional Elective (PE) courses include the elective courses relevant to the chosen specialization/ branch.

iv. Project Work (PW) includes Project Work to be done in final semester

v. Career Enhancement Courses (CEC) includes Mini Project Work and/or Internship, Seminar, Professional Practices, Summer Project, Case Study and Industrial / Practical Training.

vi. Open Elective Courses (OEC) include the courses credited from other post graduate Programmes of M.E. / M.Tech. / M.B.A / M.C.A and online courses.

6.3 Number of courses per semester

Curriculum of a semester shall normally have a blend of lecture courses and practical courses including Career Enhancement Courses. Each course may have credits assigned as per clause 6.4.

6.4 Credit Assignment

Each course offered is given a L-T-P-C structure, depending on the number of Lecture (L),number of periods for Tutorial periods (T), number of periods for practical (P),C- credits required for an efficient teaching – learning process. A student is expected to put-in his/her own efforts in proportion with periods spent in classroom, as defined in L-T-P-C structure. On successful completion of the course a student is said to have earned a specified number of credits defined for each course. Each course is assigned certain number of credits based on the following table :

Table 2 : Credit Assigned

Contact period per week	Credits
1 Lecture (**L**)	1
1 Tutorial (**T**)	1
1 Practical Period (**P**) (Laboratory / Seminar /Project work etc.)	1 / 2

6.5 Project Work

6.5.1 The project work for M.E. / M.B.A / M.C.A. Programmes consist of Project Work - I and Project Work - II. The Project Work - I is to be undertaken during Semester III and Project Work - II, which is a continuation of Project Work - I, (except when project work II is carried out in the industry) is to be undertaken during Semester IV.

6.5.2 In case of students of M.E. Programmes not completing Project Work - I of project work successfully, the students can undertake Project Work - I again in the subsequent semester. In such cases the students can enroll for Project Work - II, only after successful completion of Project Work - I.

6.5.3 Project work shall be carried out under the supervision of a “qualified teacher” in the Department concerned. In this context “qualified teacher” means the faculty member possessing (i) PG degree with a minimum of 3 years experience in teaching or (ii) Ph.D. degree.

6.5.4 A student may, however, undergo Project Work - II (M.E. / M.Tech. Programme) in industry / academic institution of repute offering PG programmes in Engineering/ Technology (other than affiliated colleges of Anna University) / research institutions for a minimum of 16 weeks during the final semester. In such cases, the students shall undergo the Project Work - II with the approval obtained from the Head of the institution and Centre for Academic Courses preferably one month before the start of the industrial project.

6.5.5 The Project Work - II carried out in industry / academic institution of repute / research institutions need not be a continuation of Project Work - I. In such cases, the Project Work shall be jointly supervised by a supervisor of the department and an expert as a joint supervisor from the organization and the student shall be instructed to meet the supervisor periodically and to attend the review committee meetings for evaluating the progress. The review meetings, if necessary, may also be arranged in online mode with prior approval from the Head of the Institution and suitable record of the meetings shall be maintained.

6.5.6 The Project Work (Project Work - II in the case of M.E. / M.Tech.) shall be pursued for a minimum of 16 weeks during the final semester.

6.5.7 The deadline for submission of final Project Report (Project Work - II for M.E. / M.Tech. programmes) is 60 calendar days from the last working day of the semester in which project work / thesis / dissertation is done. However, the Project Work - I in the case of M.E. / M.Tech. / M.B.A / M.C.A Programmes shall be submitted within the last working day of the semester as per the academic calendar.

6.5.8 Industry Supported Project Work

The students satisfying the following conditions shall be permitted to carry out their final semester Project work for six months in industry/research organization.

The student should not have current arrears and shall have CGPA of 8.0 and above until 2nd semester (for M.B.A. / M.E. / M.Tech / M.C.A. Students). The student shall undergo the final semester courses in the Pre semester. The Head of Department, in consultation with the faculty handling the said courses shall forward the proposal recommended by the Principal to CoE after approval from AEC at least four weeks before the commencement of the pre - semester of the programme.

6.6 Career Enhancement Courses

6.6.1 Industrial Training / Internship

Students shall undergo industrial training/Internship if mandated in the curriculum for periods as specified in the curriculum during the summer/winter vacation, the training being taken on a continuous basis for the periods mentioned. The industry/organization is to be selected with the approval of the Department Evaluation Committee (DEC). Industrial training may also be referred to as “In-plant training”.

The Industrial Training / Internship shall carry 100 marks and shall be evaluated through CIA only. The credit will be awarded to the student after the submission of Internship / Training report to the HoD. The report will be evaluated by a team of (DEC) faculty members nominated by the HoD for awarding the Credit. Based on the recommendation by the team, the student will be awarded credits and the results will be sent to the Controller of Examinations. The awarded credit will taken for CGPA calculation. The final year project period at industry / research organization will not be considered as industrial Training / internship.

6.6.2 If Industrial Training/ Internship is not prescribed in the curriculum, the student may undergo Industrial Training/ Internship during Summer/Winter vacation optionally and the credits earned will be indicated in the Grade Sheet. If the student earns three credits in Industrial Training/ Internship, the student may drop one Professional Elective (only one professional elective can be dropped). In such cases, Industrial Training / Internship need to be undergone continuously from one organization or with a combination one two week and one four week programme, from one/two organizations. However, if the number of credits earned is 1, these credits shall not be considered for classification of the degree. Students shall get permission from the Head of the Institution for taking industrial training/internship and the Certificate of completion of Industrial Training / Internship shall be forwarded to COE.

DURATION OF TRAINING / INTERNSHIP	CREDITS
3 Weeks*	1

6.6.3 Professional Certificate Courses

Students have to undergo one credit courses offered by experts from industry / research organizations and approved by academic council. Students can register such courses from his/her second year of study as and when these courses are conducted by the departments. A student is also permitted to register for these courses of other departments.

If a student does not successfully complete the registered industry supported one credit courses in a semester, the registration of that course will be considered as cancelled. Further, it will not be treated as arrear and if he/she wishes, he/she can re-register for the same course in the ensuing semesters and successfully complete it as and when it is offered subsequently.

6.6.4 Online Courses offered through SWAYAM / NPTEL

Students may be permitted to register maximum of two online courses, subject to a maximum of three credits, registered through SWAYAM/NPTEL instead of Professional/ Open Elective Courses are permitted for credit transfer) of regular M.E./M.Tech./ M.B.A/M.C.A Programme with the approval of BOS through DEC. The online course of minimum 3 credits can be considered instead of one Professional / Open elective course.

DEC finalizes the courses to be permitted for credit transfer through SWAYAM/ NPTEL prior to the commencement of the semester. The courses selected through the SWAYAM/NPTEL may not be necessarily the courses which are offered in the list of Professional/Open Elective courses, as part of the curriculum.

The Committee also intimates the students about the selected courses prior to the commencement of the semester, identify and designate a Course Coordinator for the online course(s) offered. The Course Coordinator guides the students throughout the course, submits the certificates and marks earned by the students to the office of the CoE during credit transfer request by the student.

The student has to register for the credit transfer of the online course during the course registration. The online course(s) which is/are successfully completed by the student in a particular semester during the course of study is eligible for credit transfer in the immediate next semester by registering it (i.e. an online course is eligible for credit transfer in the immediate next semester only)

6.6.5 Soft Skills (only for M.B.A. & M.C.A.)

Every Student is required to go for two soft skill courses during first year of study. The soft skill course includes the communication skill, interpersonal skill and career development courses. Two credit will be awarded for each soft skill courses and it will be included for GPA/CGPA calculations.

6.7 Course Numbering Scheme

Each course is denoted by a unique code consisting of 9 alphanumeric characters. The details of the numbering scheme are in APPENDIX A

6.8 Credit Requirement for Programmes

The total number of credits that a student earns during the period of study is called the Total credits. The minimum prescribed credits required for the award of the degree shall be within the limits specified below :

Programme	KIT Credit Range
M.E.	69-79
M.B.A.	102
M.C.A.	84

7. DURATION OF THE PROGRAMMES

7.1 The minimum and maximum period for completion of the P.G. Programmes are given below :

Programme	Min. No. of Semesters	Max. No. of Semesters
M.E. (Full-Time)	4	8
M.B.A. (Full Time)	4	8
M.C.A. (Full Time)	4	8

7.2 The Curriculum and Syllabi of all the P.G. Programmes shall be approved by the Academic Council of KIT. The number of Credits to be earned for the successful completion of the programme shall be as specified in the Curriculum of the respective specialization of the P.G. Programme

7.3 Each semester normally consists of 90 working days, including test and examination days. In any contingent situation, the number of working days per semester shall not be less than 65 days. The Principal is given the discretionary powers to decide the number of working days. In such contingencies, the Principal shall ensure that every faculty member teaches the full content of the specified syllabus for the course being taught.

7.3.1 Due to Pandemic / Abnormal situations the Scheme of Examinations and Evaluation will be followed as per the guidelines issued by the Government of Tamil Nadu and Anna University, Chennai.

7.4 The total period for completion of the programme reckoned from the commencement of the first semester to which the candidate was admitted shall not exceed the maximum period specified in clause 7.1 irrespective of the period of break of study in order that he/she may be eligible for the award of the degree

7.5 For the purpose of regulations, the academic year will be divided into two semesters, the odd semester normally spanning from June to November and the even semester from December to May.

8. COURSE REGISTRATION

Each student, on admission shall be assigned to a mentor who shall advice and counsel the student about the details of the academic programme and choice of courses, considering the student's academic background and career objectives. Some courses require students to register through a course registration process via online.

8.1 Course Registration

Each student on admission shall register for all the courses prescribed in the curriculum in the students first semester of the study.

The registration process for the courses offered in the online registration mode in the forthcoming semester, will commence preferably 10 working days prior to the last working day of the current semester.

A department shall offer a course only if a minimum number of students register for that course. This minimum number may vary from course to course and shall be specified by the department from time to time.

After registering for a course, a student shall attend the classes, satisfy the attendance requirements, earn Continuous Assessment Marks and appear for the End Semester Examination (ESE).

8.2 Credits details for Course Registration

Each student has to register for all courses to be undergone in the curriculum of a particular semester (with the facility to drop courses to a maximum of 6 credits). The student can also register for courses for which the student has failed in the earlier semesters.

The registration details of the candidates may be approved by the Head of the Institution and forwarded to the Controller of Examinations. This registration is for undergoing the course as well as for writing the End Semester Examinations.

The courses that a student registers in a particular semester may include

- Courses of the current semester.
- The core (Theory / Lab / CEC) courses that the student has not cleared in the previous semesters.
- Elective courses which the student failed (either the same elective or a different elective)

8.3 Flexibility to Drop courses

A student has to earn the total number of credits specified in the curriculum of the respective programme of study in order to be eligible to obtain the degree. However, if the student wishes, the student is permitted to earn more than the total number of credits prescribed in the curriculum of the student's programme.

From the Second to final semesters, the student has the option of registering for additional courses or dropping existing courses. Total number of credits of such course cannot exceed 6.

However the maximum number of credits the student can register in a particular semester cannot exceed 30 credits (excluding courses for which the student has done reappearance registration (vide clause 8.4).

The student shall register for the project work phase I in the third semester and project work phase II in the fourth semester. However, if a student has not earned the minimum number of credits as specified in table 1, the student may be permitted to register for the project work Phase I and Phase II as and when the student earns the minimum number of credits.

8.4 Reappearance Registration

8.4.1 If a student fails in a theory or practical course, the student shall do reappearance registration for that course in the subsequent semester by retaining the Continuous Assessment Marks already earned.

8.4.2 If the theory course, in which the student has failed, is a Professional Elective or an Open Elective, the student may register for the same or any other Professional Elective or Open Elective course respectively in the subsequent semesters. Such changes can be done only with due approval by DEC.

8.4.3 The student who fails in Project work/ Seminar other than Practical courses shall register for the same in the subsequent semester and reappear for the End Semester Examination.

8.4.4 If a student is not eligible to appear for end semester examination of a course due to lack of attendance, the student has to register for that course again, when offered next, attend the classes and fulfill the attendance requirements. If the course, in which the student has lack of attendance, is an elective, the student may register for the same or any other elective in the subsequent semesters.

8.4.5 If a student has completed the 6 semesters and has obtained RA grade in one or more courses, he can register and appear for arrear examination directly whenever conducted next.

8.4.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear the same course for improvement of Grade/ Marks.

9. REQUIREMENTS FOR APPEARING ESE

9.1 A student who has fulfilled the following conditions (vide clause 9.1 and 9.2) shall be deemed to have satisfied the attendance requirements for appearing for end semester examination of a particular course.

9.2 Ideally every student is expected to attend all periods and earn 100% attendance. However, the student shall secure not less than 80% attendance course wise taking into account the number of periods required for that course as specified in the curriculum.

i. If a student secures not more than 80% attendance in any Course in the Current Semester due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International Level Sports events with prior permission from the Head of the Department concerned, the student shall apply for condonation with a prescribed condonation fee payable per course. The condonation should be decided by a condonation recommendation committee consisting of Head of the Department of the student, Programme coordinator of the student, Student Counsellor, Faculty incharge of the course and Controller of Examinations. The committee scrutinizes the genunity of the "Condonation application Form" and conduct of the student and recommend it to the Principal and Chairman to grant of condonation after satisfying the requirements specified in clause 9.2 (ii). In such cases, his / her conduct has been certified to be satisfactory by the Faculty Advisor / Student Counsellor concerned and the Head of the Department.

ii. The student applied for condonation, has to compensate the shortfall periods to 80% by attending the contact classes scheduled by the Course Incharge (One week before the commencement of subsequent semester). The results of the End Semester Examination of such courses will be published only after the shortfall period is condoned by the PRINCIPAL.

9.3 A student shall normally be permitted to appear for end semester examination of the course if the student has satisfied the attendance requirements (vide Clause 9.1 – 9.2) and has registered for examination in those courses of that semester by paying the prescribed fee.

9.4 Students who do not satisfy clause 9.1 and 9.2 and who secure less than 70% attendance in a course will not be permitted to write the End-Semester Examination of that course. The student has to register and repeat this course in a subsequent semester when it is offered next (vide clause 8.4).

9.5 In the case of reappearance registration for a course (vide Clause 8.4), the attendance requirement as mentioned in Clauses 9.1 - 9.3 is not applicable. However, the student has to register for examination in that course by paying the prescribed fee.

9.6 A student who has already appeared for a course in a semester and passed the examination is not entitled to reappear in the same course for improvement of grades.

10. PROVISION FOR WITHDRAWAL FROM EXAMINATION

A student may, for valid reasons (medically unfit / unexpected family situations / Sports person representing Tamilnadu / India with prior permission for participation from Principal / CoE / DEC), be granted permission to withdraw (after registering for the examinations) from appearing for any course or courses in the End Semester Examination of a particular semester. The student may withdraw by following the due process of the CoE's office before the commencement of examination. This facility can be availed only once during the entire duration of the degree programme.

Withdrawal from ESE will be valid only if the student is, otherwise, eligible to write the examination and the application for withdrawal is made to the CoE, prior to the examination in the course or courses concerned. The application for withdrawal should be recommended by the Head of the Department concerned and approved by the Head of the Institution.

11. TEMPORARY BREAK OF STUDY FROM A PROGRAMME

11.1 Break of study is normally not permitted. However, if a student intends to temporarily discontinue the programme in the middle of a semester / year for valid reasons (such as Internships, accident or hospitalization due to prolonged ill health) and wishes to re-join the programme in the next academic year, he / she shall apply in advance to the Principal through the Head of the Department, stating the reasons. The application shall be submitted not later than the last date for registering for the semester examinations. Break of study is permitted only once during the entire period of the degree programme.

11.2 The student permitted to re-join the programme after the break shall be governed by the rules and regulations in force, at the time of re-joining.

11.3 The duration specified for passing all the courses for the purpose of classification of degree(vide clause 20) shall be increased by the period of such break of study permitted(vide clause 11)

11.4 If a student is detained for want of requisite attendance, academic progress and good conduct, the period spent in that semester shall not be considered as permitted Break of Study and Clause 11.3 is not applicable for such cases.

A student may, for valid reasons (medically unfit / unexpected family situations/Sports person representing Tamilnadu / India with prior permission for participation from Principal / CoE / DEC), be granted permission to withdraw (after registering for the examinations) from appearing for any course or courses in the End Semester Examination of a particular semester. The student may withdraw by following the due process of the CoE's office before the commencement of examination. This facility can be availed only once during the entire duration of the degree programme.

Withdrawal from ESE will be valid only if the student is, otherwise, eligible to write the examination and the application for withdrawal is made to the CoE, prior to the examination in the course or courses concerned. The application for withdrawal should be recommended by the Head of the Department concerned and approved by the Head of the Institution.

12. ASSESSMENT PROCEDURES FOR AWARDING MARKS

All PG Programmes consists of different categories of courses as mentioned in table 4. Appearance in End Semester Examination is mandatory for all courses excluding the courses for which only continuous assessment is recommended as mentioned in table 4. Performance in each course of study shall be evaluated based on (i) Continuous assessments throughout the semester and (ii) End Semester Examination at the end of the semester. (i.e.) Each course shall be evaluated for a maximum of 100 marks as shown below :

Table 3 – Categories of Courses

Sl.No.	Category of Course	Continuous Assessment Marks	End - Semester Examination Marks
1.	Theory	40	60
2.	Theory cum Practical	50	50
3.	Practical	60	40
4.	Project Work	40	60
5.	Online SWAYAM / NPTEL Courses (Optional)	Marks offered by SWAYAM / NPTEL shall be directly considered	
6.	All EEC Courses (Except Practical Courses and Project Work)	100	-
7.	Mandatory Courses (Except Induction Program#)	100	-

* Value Added Courses (comes under EEC) No assessment for Induction program.

Every course coordinator is required to maintain an ATTENDANCE AND ASSESSMENT RECORD' for every semester which consists of attendance marked in each Theory / practical / EEC class etc, the assessment marks and the record of class work (topics covered), separately for each course handled by the course coordinator. This should be submitted to the HOD periodically (at least two times in a semester) for checking the syllabus coverage and the records of assessment marks and attendance. The HOD will affix his/her signature and date after due verification. At the end of the semester, the record should be verified by the HOD who shall keep this document after the approval from the Principal for five years. The records of attendance and assessment of both current and previous semesters should be available for inspection whenever required.

12.1 Assessment for Theory Courses Including Mandatory Courses

Theory Courses including mandatory courses are to be assessed out of 100 marks, the maximum marks for CIA is fixed as 40 and the ESE carries 60 marks.

The ESE for theory courses including mandatory courses will be of 3 hours duration and shall normally be conducted for a maximum of 100 marks during the Odd and Even Semesters. Every student should appear for the ESE for all the courses excluding the courses for which only continuous assessment is recommended.

A minimum of two tests would be conducted in a day (in the case of tests and they would be of two hours duration each) students will have two hours of coaching session followed by the CIA. In case a student misses the assessment due to medical reasons (hospitalization / accident / specific illness) or due to participation in the College / University / State / National / International level Sports events with prior permission from the HOD, a Reassessment may be given at the end of the semester after getting approval from the HOD through the Course Coordinator concerned.

To arrive the Continuous Assessment Marks, the following guidelines should be followed

Table : 4 Theory Courses : Continuous Assessment Marks

Assessment I (100 Marks)		Assessment II (100 Marks)		Assessment III (100 Marks)		Total
Individual Assignment / Case Study / Seminar / Mini project	Written Test	Individual Assignment / Case Study / Seminar / Mini project	Written Test	Individual Assignment / Case Study / Seminar / Mini project	Written Test	Total Continuous Assessment Marks
40	60	40	60	40	60	300*

*The weighted average shall be converted into 40 marks for Continuous Assessment

A minimum of three Continuous assessments will be conducted as a part of continuous assessment during the semester by the respective department. Each Continuous assessment is to be conducted for 100 marks and will have to be distributed in two parts viz., Individual Assignment/Case study/Seminar/Mini project and Test with each having a weightage of 40% and 60% respectively. The tests shall be in written mode. The total Continuous assessment marks of 200 shall be converted into a maximum of 40 marks and rounded to the nearest integer.

12.2 Assessment for Practical Courses

For practical including virtual practical Courses, out of 100 marks, the maximum marks for Continuous Assessment is fixed as 60 and the End Semester Examination carries 40 marks.

Every practical exercise / experiment shall be evaluated (as per the rubrics approved by the class committee) based on conduct of experiment / exercise and records. There shall be at least one model test. The criteria for arriving at the Continuous Assessment marks of 60 is as follows :

Table : 5 Practical Courses : Continuous Assessment Marks

Continuous Assessment (100 Marks)*	
Evaluation of Laboratory Observation, Record	Test
75	25

*Continuous Assessment marks shall be converted into 60 marks

The End Semester examinations for practical courses shall be of 3 hours duration and normally be conducted for a maximum of 100 marks during the odd and Even Semesters.

12.3 Assessment for Theory cum Practical Courses

Weightage of Continuous Assessment and end semester examination marks will be 50% each. The distribution of marks for the theory and laboratory components in the Continuous Assessment and end semester examination for different types of courses are provided in the table 7.

Table : 6 Theory Courses with Practical Component : Continuous Assessment Marks

L	T	P	C	Continuous Internal Assessment			ESE
				I	II	III	
1	0	4	3	Laboratory (15%)	Laboratory (15%)	Theory (20%)	Laboratory only (50%)
1	0	2	2	Laboratory (15%)	Laboratory (15%)	Theory (20%)	Laboratory only (50%)
2	0	2	3	Theory (15%)	Theory (15%)	Laboratory (20%)	Theory (25%) Laboratory (25%)
3	0	2	4	Theory (15%)	Theory (15%)	Laboratory (20%)	Theory (35%) Laboratory (15%)
2	0	4	4	Theory (15%)	Theory (15%)	Laboratory (20%)	Theory (15%) Laboratory (35%)

The procedure for the conduct of Continuous Internal Assessment for theory and laboratory components shall be as per the clause 13.1 and 13.2 respectively. The weighted average shall be converted into 50 marks for Continuous Assessment.

12.4 Assessment for Project Work

The Project work such as mini project and final year project shall be carried out under the supervision of a faculty in the department concerned.

The students who completed their final semester courses (except project work) in advance, shall be permitted to carry out their final semester Project Work for six months in an industry/research organization on the recommendations of the HoD. In such cases the approval should be obtained from the industry concerned, the project work shall be jointly guided by a supervisor of the department and an expert as joint supervisor from the respective organization. The student shall be instructed to meet the supervisor periodically and to attend the review committee meetings and shall submit attendance particulars from the joint supervisor for evaluating the progress

For Project Work, out of 100 marks, the maximum marks for CIA is fixed as 40 and the ESE (Project Report evaluation and Viva-Voce examination) carries 60 marks. Project work may be carried out by a single student.

There shall be three reviews during the semester. The student shall make presentation on the progress made by him / her before the “Project Review Committee”. The total marks obtained in the three reviews shall be reduced for 40 marks and rounded to the next integer. The HoD shall constitute a “Project Review Committee” for each Programme. There shall be a minimum of three members in the Review Committee. The Project Guide will be one of the members of the Review Committee.

The student is expected to submit the Project Report on or before the notified date. The ESE for Project Work shall consist of evaluation of the final Project Report submitted by the student of the Project and viva-voce examination by an external examiner and internal examiner.

The project report shall carry a maximum of 20 marks. The project report shall be submitted as per the approved guidelines as given by the CoE. Same marks shall be awarded to every student within the project group for the project report. The viva-voce examination shall carry 40 marks. Marks are awarded to each student of the project group is based on the individual performance in the viva- voce examination.

The CIA and ESE marks for Project Work and the Viva-Voce Examination will be distributed as indicated below.

Table 7 : Project Work : CIA and ESE

Continuous Internal Assessment Marks (40)			End Semester Examinations Marks (60)			
Review I	Review II	Review III	Project Report		Viva-Voce Examination	
10	15	15	Internal	External	Internal	External
			10	10	20	20

The last date for submission of the project report is on the last working day of the semester. If a student fails to submit the project report on or before the specified deadline or the student has submitted the project report but did not appear for the viva-voce examination, it will be considered as fail in the Project Work and the student shall re-register for the same in the subsequent semester.

The Project Report prepared according to approved guidelines as given by the Institution and duly signed by the supervisor, Programme Co-ordinator and the Head of the Department.

The evaluation of the Project work Phase - I and Phase - II will be based on the project report submitted in each of the Phase – I and Phase - II semesters respectively and a Viva-Voce Examination by a team consisting of the supervisor and External Examiner. The external examiner shall be appointed by the Office of the Controller of Examinations from the panel of examiners recommended by the HOD for Phase - I and Phase - II project evaluation.

If the student fails to obtain 50% of the continuous assessment marks in the phase - I and Phase - II project work, he / she will not be permitted to submit the report for that particular semester and has to re-enroll for the same in the subsequent semester.

The Project Report / Thesis / Dissertation report / Drawings prepared according to approved guidelines and duly signed by the supervisor(s), the Programme Coordinator and the Head of the Department shall be submitted at the end of the IIIrd and IVth semester. If a candidate submits the project report/thesis report/dissertation after the specified deadline, he/she is deemed to have failed in the Project Work/Thesis/Dissertation and shall re-enroll for the same in a subsequent semester.

If a student fails to submit the project report on or before the specified deadline, student is deemed to have failed in the project work and shall re-enroll for the same in a subsequent (next) semester. This applies to both phase - I and phase - II project work. In case of students not completing phase - I of the project work successfully, the students can undertake phase - I again in the subsequent (next) semester. In such cases, the students can enroll for Phase - II, only after successful completion of Phase I.

12.5 Assessment for Industrial Training / Practical Training / Internship

The Industrial training / Practical Training /Internship shall carry 100 marks and shall be evaluated through Continuous Assessment only. At the end of Industrial training / Practical Training/Internship, the student shall submit a detailed report including attendance on the training undergone and a certificate from the organization concerned. The evaluation will be made based on this report and a Viva-Voce Examination, conducted internally by a three-member Departmental Consultative Committee constituted by the HOD consisting of Programme Coordinator, Faculty Advisor concerned and Senior Faculty. The evaluation report duly signed by the departmental consultative committee and HOD shall be submitted to the office of the COE.

12.6 Assessment for other Career Enhancement Courses

The Seminar / Case Study shall carry 100 marks and shall be evaluated through Continuous Assessment only. Every student is expected to present a minimum of 2 seminars per semester before the evaluation committee and for each seminar, marks can be equally apportioned. A three member committee appointed by the Head of the Department, consisting of the course coordinator and two experts from the Department, will evaluate the seminar and at the end of the semester, the marks shall be consolidated and taken as the final mark. The evaluation shall be based on the seminar paper (40%), presentation (40%) and response to the questions asked during presentation (20%).

12.7 Assessment for SWAYAM/NPTEL Courses

The students may be permitted to credit online courses which are offered through SWAYAM / NPTEL platform with the approval of Board of Studies concerned (vide Clause 6.5.4). The course shall carry 100 marks and the marks awarded by the SWAYAM / NPTEL shall be directly considered for grading of the course. No grades shall be awarded for the attendance in the grade sheet for the online course. The attendance requirement as mentioned in Clauses 7 of Regulations 2023 is not applicable for the SWAYAM / NPTEL course.

12.8 Research Publication

The student can register for the Research Publication as a value added course of respective credits with the approval of BoS concerned. Maximum of two students can form a team under the guidance of a faculty member and complete the publication in SCI / SCI expanded / SCOPUS indexed / UGC Care list. Credits for the publication will be awarded as mentioned in Table 09. The students are not allowed for credit transfer for the research publication. The research publication completed in a semester during the course of study is eligible for including in the grade sheet in the immediate next EVEN/ODD by registering it.

Table : 8 Research Publication : Award of Letter Grade

Sl.No	Category of Journal	Credits
1.	One Research Publication in SCI / SCI - Expanded Journal	3
2.	One Research Publication in SCOPUS indexed Journal	2
3.	One Research Publication in UGC Care list Journal	1

13. MARKS DISTRIBUTION

13.1 Question paper pattern

Table : 9 End Semester Examinations

1 Mark (Objective or any type)	2 Marks	13 Marks	Total Marks
15	10	5 (Either or Type)	100
For Mathematics paper only			
2 Marks	**16 Marks**		**Total Marks**
10	5 (Either or Type)		100

14. PASSING REQUIREMENTS

14.1 A student who secures not less than 50% of total marks prescribed for the course [Continuous Assessment + End semester Examinations] with a minimum of 50% of the marks prescribed for the end-semester Examination, shall be declared to have passed the course and acquired the relevant number of credits. This is applicable for theory, theory with practical component and practical courses (including project work).

14.2 If a student fails to secure a pass in a theory course / theory with practical component / practical course (except electives), the student shall register and appear only for the end semester examination in the subsequent semester. In such case, the Continuous assessment marks obtained by the student in the first appearance shall be retained and considered valid for all subsequent attempts till the student secures a pass. However, from the third attempt onwards if a student fails to obtain pass marks (Continuous Assessment + End Semester Examination), then the student shall be declared to have passed the examination if he/she secures a minimum of 50% marks prescribed for the end semester examinations alone.

14.3 If the course, in which the student has failed, is a Professional Elective or Open Elective course, the student may be permitted to register for the same or any other elective course in the subsequent semesters.

If any other Professional Elective or Open Elective course is opted by the student, the previous registration is cancelled and henceforth it is to be considered as a new Professional Elective or Open Elective course. The student has to register and attend the classes, earn the continuous assessment marks, fulfil the attendance requirements as per clause 9 and appear for the end semester examination.

14.4 If a student fails to secure a pass in project work, the student shall register for the course in the subsequent semester/when offered next and repeat the course.

14.5 The passing requirement for the courses which are assessed only through purely internal assessments (EEC courses except Project Work and laboratory), is 50% of the internal assessment (continuous assessment) marks only

14.6 Valued Answer Script review by the students

All the students are allowed to review their valued answer scripts with the faculty in-charge of the course on the specified date (usually the reopening day). Any discrepancies in the valuation can immediately be brought to the notice of the Controller of Examinations.

14.7 Revaluation

A student can apply for revaluation in a theory course within 2 working days from the date of review of valued answer scripts by the students on payment of a prescribed fee along with prescribed application to the COE through the HOD. The COE will arrange for the revaluation and the following procedure is followed in awarding Grade Points after revaluation:

i. If there is a change from fail to pass for a Candidate in a Course, Grade Point is awarded as per the applicable (relative/absolute) grading.

ii. If a passed candidate in a course obtains more marks after revaluation, Revised Grading is used only when the candidate gets Higher Grade, otherwise no change in the grade awarded before the revaluation.

The results will be intimated to the student concerned through the HOD within 5 working days from the last date of application of revaluation. Revaluation is not permitted for practical course, practical component of theory with practical component courses and project work.

14.8 Photocopy

Photo Copies of answer script for theory subjects can be obtained from the office of the Controller of Examinations on payment of a prescribed fee specified for this purpose through proper application.

14.9 Challenge Revaluation

Challenging the revaluation is permitted for those students who have applied for photocopy of answer script. The copy of the answer script is to be valued by a competent authority and the valued script should be submitted to the office of the COE along with prescribed fee for challenging the revaluation within 2 working days after the declaration of the Re-valuation results

15. AWARD OF LETTER GRADES

15.1 The award of letter grades will be decided based on relative grading principle. The relative grading is applicable to ONLY those students who have passed the examination as per the passing requirements enumerated above (vide clause 14). For those students who have not passed the examination, Reappearance (U) shall be awarded as shown in the below Table 10.

For those students who have passed the course, the relative grading shall be done. The marks of those students who have passed only shall be considered for relative grading. The

evolved relative grading method normalizes the results data using the BOX-COX transformation method and computes the grade range for each course separately and awards the grade to each student. For a given course, if the students' strength is greater than 30, the relative grading method shall be adopted. However, if the students' strength is less than 30 then the absolute grading shall be followed with the grade range as specified below.

Table : 10 Letter Grades and Range of Marks

O	A+	A	B+	B	C	RA
91 - 100	81 - 90	71 - 80	61 - 70	56 - 60	50 - 55	< 50

The performance of a student shall be reported using letter grades, each carrying certain points as detailed below :

Table :11 Letter Grades and Grade Points

LETTER GRADE	GRADE POINTS	RESULT
O (Outstanding)	10	PASS
A+ (Excellent)	9	
A (Very Good)	8	
B+ (Good)	7	
B (Average)	6	
C (Satisfactory)	5	
U (Re-appearance)	0	RA (Re-appearance)
SA (Shortage of Attendance)	0	RC (Repeat Course)
WD (Withdrawal)	0	EA (Extended Appearance)
AB (Absent)	0	RA (Re-appearance)
WH (Withheld)	0	RA (Re-appearance)

15.2 For a student who does not meet the minimum passing requirements, the term "RA" against the course will be indicated in his/her grade sheet. He/she shall reappear in the subsequent examinations for the course as arrear or re-register for the course when offered .

15.3 For a student who is absent for end-semester theory / practical / project viva-voce, the term "RA" will be indicated against the corresponding course. He/she shall reappear for the End Semester Examination of that course as arrear in the subsequent semester or when offered next. .

15.4 The letter grade "W" will be indicated for the courses for which the student has been granted authorized withdrawal (refer Clause 10).

15.5 For mandatory courses (non-credit), the student must satisfy the minimum attendance requirement & passing criteria as specified for the course as detailed in clause 9.

16. METHODS FOR REDRESSAL OF GRIEVANCES IN EVALUATION

Students who are not satisfied with the grades awarded in the End Semester Examination of Theory for regular and arrear exams can seek redressal as illustrated in Table 11

Table 12 : Grievance Redressal Mechanism

Sl. No.	Redressal Sought	Methodology	
		Regular Exam	Arrear Exam
1.	Revaluation	⦿ Apply for viewing of answer booklet and then apply for revaluation after course expert recommendation	
2.	Challenge of Evaluation	⦿ Apply for viewing of answer booklet and then apply for revaluation after course expert recommendation. ⦿ Next apply for challenge of evaluation.	
Note : All applications to be made to COE along with the payment of the prescribed fee.			

16.1 Challenge of Evaluation – Flow Process

Table 13 : Evaluation – Flow Process

Step 1	A student can make an appeal to the CoE for the review of answer scripts after paying the prescribed fee.
Step 2	CoE will issue the viewing of answer scripts to the student.
Step 3	The faculty who had handled the subject will evaluate the script and HoD will recommend.
Step 4	A committee consisting of 2 evaluators appointed by CoE will review and declare the result.
Step 5	If the result is in favour of the student, the fee collected will be refunded to the student.
Step 6	The final mark will be announced by CoE.

16.2 Grading for Mandatory Courses

Mandatory Courses are courses that are required to be completed to fulfill the degree requirements (e.g. Human excellence, Environmental science, etc.). They are normally non – credit based. These courses will not be taken in to consideration for the SGPA / CGPA calculations. Each of these courses is assessed continuously and internally for a total mark of 100. The pass mark is 50%. Students, who fail to pass this course, are required to repeat the course, when offered next.

16.2.1 For Mandatory non-credit courses the student must satisfy the minimum attendance requirement & passing criteria as specified for the course. These courses do not carry credits but needs to be completed to fulfill the degree requirements.

16.2.2 For the Mandatory non-credit courses student completing the course will be awarded Pass grade (P) and those who fail to satisfy the attendance requirement or fail to satisfy the minimum passing requirement of 50% marks, will be awarded Fail (F) grade and the student must re-register for the course when it is offered next.

16.3 Grade Sheet

After the results are declared, grade sheets will be issued to each student, which will contain the following details :

- The College Name and Affiliating University.
- The list of courses registered during the semester and the grades scored.
- The Grade Point Average (GPA) for the semester.
- The Cumulative Grade Point Average (CGPA) of all courses registered from first semester onwards.
- On completion of a semester, each student is assigned a GPA which is computed as below for all courses registered for, by the student during that semester.
- $GPA = \frac{\sum(C_i \times GP_i)}{\sum C_i}$

where $\mathbf{C_i}$ is the credit for a course in that semester and $\mathbf{GP_i}$ is the Grade Point earned by the student for that course. The **SGPA** is rounded off to two decimals.

The overall performance of a student at any stage of the Degree programme is evaluated by the **CGPA** up to that point of time.

$$\mathbf{CGPA} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

where $\mathbf{C_i}$ is the credit for each course in each of the completed semesters at that stage and $\mathbf{GP_i}$ is the grade point earned by the student for that course. The **CGPA** is rounded off to two decimals.

16.4 Formula For Calculating Percentage

CGPA x 9.5 = % of Marks

17. ELIGIBILITY FOR THE AWARD OF DEGREE

A student shall be declared to be eligible for the award of the M.E.M.Tech. / M.B.A / M.C.A. Degree provided the student has

i. Successfully gained the required number of total credits as specified in the curriculum corresponding to the student's programme within the stipulated time.

ii. Successfully completed the course requirements, appeared for the End- Semester examinations and passed all the subjects prescribed in clause no.7.

iii. Successfully passed any additional courses prescribed by the Academic council

iv. Successfully passed any additional courses prescribed by the Department & concerned whenever readmitted under regulations 2023 (R23)

v. No disciplinary action pending against the student.

vi. The award of Degree must have been approved by the Academic Council of KIT.

18. CLASSIFICATION OF M.E. / M.Tech. / M.B.A. / M.C.A. DEGREE

The degree awarded to eligible students will be classified as given in Table 15.

Table 14 : Classification of the M.E. / M.Tech. / M.B.A. / M.C.A. Degree

Sl.No.	Class Awarded	Criteria
1.	First class with distinction	A student who satisfies the following conditions shall be declared to have passed the examination in First class with Distinction : **M.E. / M.B.A. / M.C.A** ⊙ Should have passed the examination in all the courses of all the four semesters in the student's First Appearance within three years, which includes authorised break of study of one year (if availed). Withdrawal from examination will not be considered as an appearance. ⊙ Should have secured a CGPA of not less than 8.50. ⊙ Should NOT have been prevented from writing end Semester examination due to lack of attendance in any of the courses
2.	First Class	A student who satisfies the following conditions shall be declared to have passed the examination in First class: **M.E. / M.B.A./ M.C.A** ⊙ Should have passed the examination in all the courses of all four semesters **within three years**, which includes one year of authorized break of study (if availed) or prevention from writing the End Semester Examination due to lack of attendance (if applicable). ⊙ Should have secured a CGPA of not less than **6.50**.
3.	Second Class	All other students (not covered in clauses Sl.No. 1 and 2 under clause 19) who qualify for the award of the degree (vide Clause 20) shall be declared to have passed the examination in Second Class.
Note : A student who is absent for the End Semester Examination in a course / project work Viva Voce after having registered for the same will be considered to have appeared for that examination (except approved withdrawal from End Semester Examinations as per Clause 9) for the purpose of classification.		

19. PROVISION FOR WITHDRAWAL FROM EXAMINATION

19.1 A student may, for valid reasons, (medically unfit/ unexpected family situations/ sports approved by the Chairman) be granted permission to withdraw from appearing for the ESE in any Course or Courses in ANY ONE of the Semester examinations during the entire duration of the Degree Programme. The application shall be sent to the Principal and Chairman through HoD with required documents for approval.

19.2 Withdrawal application shall be valid only if the student is eligible to write the Examination (Clause 7) and if it is made within TEN working days before the commencement of the ESE in that Course or Courses and also recommended by the HoD.

19.3 Notwithstanding the requirement of mandatory TEN working days notice, applications for withdrawal for special cases under extraordinary conditions will be considered on the merit of the case.

19.4 If a student applies for withdrawal from Project Work, he/she will be permitted for the withdrawal only after the submission of project report before the deadline. However, the student may appear for the viva voce examination within 30/60 days after the declaration of results for Project Work and the same shall not be considered as reappearance.

19.5 Withdrawal shall not be considered as an appearance for deciding the eligibility of a student for First Class with Distinction.

19.6 Withdrawal is permitted for the ESE in the final semester as per Clause 7.1.

20. BREAK OF STUDY FROM A PROGRAMME

20.1 A student is permitted to go on break of study for a single break of one year only.

20.2 The student can apply for break of study in advance, in any case, not later than the last date of the first assessment period. The application duly filled by the student shall be submitted through the HoD with the approval of the Principal.

20.3 The students permitted to rejoin the Programme after break of study / readmission due to lack of attendance, shall be governed by the curriculum and Regulations in force at the time of rejoining. The students rejoining in new regulations shall apply in the prescribed format through HoD at the beginning of the readmitted semester itself for prescribing additional/equivalent courses, if any, from any semester of the regulations in-force, so as to bridge the curriculum in-force and the old curriculum.

20.4 The total period for completion of the programme reckoned from, the commencement of the first semester to which the student was admitted shall not exceed the maximum period specified in Clause 6 irrespective of the period of break of study in order that the student may be eligible for the award of the Degree (vide Clause 16).

20.5 In case there is any period of break of study more than the permitted duration of break of study, the student shall be permitted to continue the Programme only if the approval is obtained from the Director of Technical Education / University through the concerned HoD / Principal before the end of the Semester in which the student has taken break of study.

20.6 If a student has not reported to the department for a period of two consecutive Semesters without any intimation, the name of the student shall be deleted permanently from the college enrollment.

20.7 During the break of study period, the students shall pay the prescribed tuition fees failing which the name of the student shall be deleted permanently from the enrollment. Such students are not entitled to seek readmission under any circumstances.

21. PROCEDURE FOR USING SCRIBE

If a candidate is physically handicapped (in case of accidents / ill health) at the time of examination, he/she may be permitted to use a scribe to write the examination. The compensatory (additional) time should be half hour for three hour duration of examination. The Scribe shall be a non-engineering student / graduate.

22. FACULTY MENTOR

To help the students in palnning their courses of study and for general advice on the academic matters, the HoD will attach a certain number of students (maximum 25) to a faculty member of the department. He/She shall function as Faculty Mentor for these students throughout their period of study. The faculty mentor shall,

- Advice the students in registering and reappearance registering of courses
- Monitor their attendance, academic progress and discipline of the students
- Counsel periodically or during the faculty mentor meeting scheduled in the class time table.
- Inform the students about the various facilities and activities available to enhance the student's curricular and co-curricular activities
- If necessary, the faculty mentor may also discuss with or inform the parents about the progress of the students through HoD or in Parent-Teacher meeting.

23. CLASS COMMITTEE

The objective of the Class Committee is to improve the teaching-learning process.

The functions of the class committee include :

- Resolving difficulties experienced by students in the classroom and in the laboratories.
- Clarifying the regulations of the degree programme and the details of rules therein.
- Discussing the progress of academic schedule and deviations if any.
- Evaluating the performance of the students of the class after each test and finding the ways and means of improvement.
- Every class in first year of study shall have a class committee consisting of faculty members who are teaching in that class, student representatives
- Cross section of students from boys and girls and a chairperson who is a faculty not handling the course for the class.

From III semester onwards, Class committee comprises of all the faculty members who are handling courses in that particular semester and two student representatives from each course. A chairperson who is a faculty not handling course for that particular semester, nominated by the HoD shall coordinate the activities of this committee.

- The class committee shall be constituted by the HoD/Chief mentor on the first week of commencement of the semester.
- The class committee shall meet three times in a semester as specified in the academic calendar.
- The Principal may participate in any class committee meeting of the institution

- During these meetings, the representative of the class shall meaningfully interact and express the opinions and suggestions of the other students of the class to improve the effectiveness of the teaching-learning process.
- The Chairperson is required to prepare the minutes of the meeting, signed by the members and submit the same to HoD within five working days of the meeting. HoD will in turn consolidate and forward the same to the Principal, within five working days of the meeting.
- In each meeting, the action taken report of the previous meeting is to be presented by the Chairperson of the class committee.

24. COMMON COURSE COMMITTEE

- A theory course handled by more than one teacher shall have a "Common Course Committee" comprising of all teachers teaching that course and few students who have registered for that course. There shall be two student representatives from each batch of that course. One of the teachers shall be nominated as Course Coordinator by the HOD concerned and duly approved by the Principal.
- The first meeting of the Common Course Committee shall be held within fifteen days from the date of commencement of the semester. The nature and weightage of the continuous assessments shall be decided in the first meeting, within the framework of the Regulations. Two or three subsequent meetings in a semester may be held at suitable intervals. During these meetings, the student members shall meaningfully interact and express their opinions and suggestions of all the students to improve the effectiveness of the teaching-learning process. It is the responsibility of the student representatives to convey the proceedings of these meetings to the whole batch.
- In addition, the "Common Course Committee" (without the student representatives) shall meet to ensure uniform evaluation of continuous assessments after arriving at a common scheme of evaluation for the assessments.
- Wherever feasible, the common course committee (without the student representatives) shall also prepare a common question paper for the CIA tests. The question paper for the ESE is common and shall be set by the Course Coordinator in consultation with all the teachers or the external member as appointed by the CoE.

25. DETAILS OF FACULTY PEDAGOGICAL AND STUDENT ASSESSMENT RECORD

Every teacher is required to maintain a Faculty Record Book/ course file consisting of the following details as shown below ;

- Time-table, course syllabus, program outcomes, course outcomes.
- Details of attendance of each student marked in each theory/practical/project work class.
- CIA marks,Details of Assignment/ seminar given, course delivery details, corrective and preventive actions on test performance of students and any other additional details.

The record book should be submitted to the HoD periodically (at least three times in a semester) for checking the syllabus covered, the test marks and attendance. The HoD shall put

his/her signature and date in the record book after due verification. At the end of the semester, the record book shall be verified by the Principal who will also ensure safe custody of the document for at least four years. The university or any inspection team appointed by the University/UGC/AICTE may verify the records of attendance.

26. DISCIPLINE

Every student is required to maintain discipline and decorum both inside and outside the institution campus. They shall follow all the rules and regulations and should not indulge in any activity which can tarnish the reputation of the Institution. The Principal shall refer any act of indiscipline by students to the Discipline and Welfare Committee and other appropriate committees for action.

27. SPECIAL CASES

In the event of any clarification in the interpretation of the above rules and relations, they shall be referred to the Standing Committee. The standing committee will offer suitable interpretations/ clarifications/amendments required for special case on such references and get them ratified in the next meeting of the Academic Council. The decision of the Academic Council is final.

ANNEXURE - I

COURSE NUMBERING SCHEME

M	1	9	M	E	T	7	0	9
Programme	Regulation		Department Code		Course Type	Semester	Sequence Number	

Programme : Masters Degree (M.E./M.Tech) - M **Regulation :** R – 19 **Department Code :** AE - Applied Electronics CS - Computer Science and Engineering ED - Engineering Design PS - Power System Engineering VD - VLSI Design CA - Computer Application MB - Management Studies EN - English MA - Mathematics CE - Career Enhancement MC - Mandatory Course	**Course Type** T - Theory P - Practical / Project / Internship E - Elective O - Open Elective C - One Credit Courses N - Online courses S - Special Electives **Semester** 1 - First Semester 2 - Second Semester 3 - Third Semester 4 - Fourth Semester **Sequence Number** 00-99

ANNEXURE - II

POLICY ON MALPRACTICES

GENERAL

- It shall be the endeavour of all concerned to prevent, control and take remedial action to bring about the occurrences of malpractices to "Zero" in Examinations (both Internal and External), Assignments and in all Academic class works.
- Therefore, a comprehensive approach to the malady of malpractices has to be adopted to create a mindset of integrity and honesty, and at the same time take sufficiently stern action to make it clear that such attempts are fraught with comparably very high risk.
- In keeping with this stance, the following measures are to be taken by all concerned from class room level to the Examination Halls:

A. PREVENTION

a. Class room level :

All faculty members are to involve themselves in a psychological growth of students by personal example and self-respect and strive towards.

- Developing a sense of honour in the minds of students so that they look down upon earning undeserved marks.
- Imbibing a sense of self-respect and internal dignity that prevents him/her from succumbing to the temptation of easy marks by cheating.
- Generating an awareness of the risks to their character and career if convicted, while also explaining the process and strict rules and regulations adopted by the educational system to prevent malpractices.
- Taking stern view of copied assignments and attempts at malpractices in internal examinations also merits equal seriousness as semester examinations.
- Setting sufficiently strong deterrent rules in place and regulations like intimation to parents and warning to students in the presence of parents etc. even in case of efforts at malpractices in internal tests and/or repeated acts despite warnings in case of assignments also.

Examination Halls

- Detailed instructions on Invigilation, question paper setting and evaluation and such other instructions will be issued for Invigilation, vigilance, which are to be brought to the notice of all students prior to the examinations.

B. PENAL ACTION FOR MALPRACTICES

All instances of malpractices will be forwarded to the Principal/ Chief Superintendents. The offences will be investigated by a Standing Enquiry Committee constituted by Principal, The committee is to summon and give the student an opportunity to present / plead his/her case. The Committee may also summon anybody else, if it so deems necessary for the conduct of enquiry, in the interest of proper investigation and dispensation of the case. The tenure of the committee would be a complete Academic year.

The Committee is to be guided by the following :

- The seriousness of the malpractice, in terms of deviousness, and culpability/ criminality of motive.
- The seriousness in terms of effort and degree of deviousness and culpability / criminality of effort.
- Any FIR/ Police case that has been registered in the first instance by the Principal/ Chief Superintendent.
- Any other special consideration either mitigating or to the contrary.

C. PENALTY FOR OFFENSES

The penalties awarded will depend on the seriousness of the offence. A list of offences and penalties are placed at **Annexure III**.

The enquiry report with findings and recommendations of the committee are to be forwarded to the Controller who will undertake necessary follow up action. Based on the recommendations of the CoE, the Principal is empowered to award penalties for offences classified as belonging to categories 1 to 7 of the offence table. The cases falling in categories from S.No. 8 onwards are to be put up to the Principal for consideration and award of suitable penalty.

APPENDIX - III

Sl.No.	Nature of Malpractice	Maximum Punishment
1.	Appeal by the candidate in the answer script to show mercy by way of awarding more than deserving marks.	Fine of Rs. 1000/- per subject.
2.	The candidate writing his/her name in the answer script.	
3.	The candidate writing his/her registration number / college name in places other than specified in the answer script	
4.	Any special marking in the answer script by the candidate.	
5.	The candidate communicating with neighbouring candidate orally or non- verbally; the candidate causing suspicious movement of his/her body.	
6.	Irrelevant writing by the candidate in the answer script.	
7.	The candidate writing answer on his/her question paper or making use of his/her question paper for rough work.	

8.	The candidate possessing cell phones / programmable calculator(s)/any other electronic storage device(s) **gadgets**	Invalidating the examination of the particular subject written by the candidate.
9.	The candidate possessing any incriminating material(s) (whether used or not). For example:- Written or printed materials, bits of papers containing written information, writings on scale, calculator, handkerchief, dress, part of the body, Hall Ticket, etc.	Invalidating the examination of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects. If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate.
10.	The candidate possessing cell phone(s)/ programmable calculator(s)/any other electronic storage device(s) **gadgets** and containing incriminating materials (whether used or not).	Invalidating the examination of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects. If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate.
11.	The Candidate possessing the question paper of another candidate with additional writing on it.	
12.	The candidate passing his/her question paper to another candidate with additional writing on it.	
13.	The candidate passing incriminating materials brought into the examination hall in any medium (hard/soft) to other candidate(s).	
14.	The candidate copying from neighbouring candidate.	
15.	The candidate taking out of the examination hall answer booklet(s), used or unused.	
16.	Appeal by the candidate in the answer script coupled with a promise of any form of consideration.	
17.	Candidate destroying evidence relating to an alleged irregularity.	Invalidating the examinations of the subject concerned and all the theory and the practical subjects of the current semester registered by the candidate. Further the candidate is not considered for revaluation of answer scripts of the arrears-subjects.

		If the candidate has registered for arrears – subjects only, invalidating the examinations of all the arrears – subjects registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears-subjects for two subsequent semesters.
18.	Vulgar / offensive writings by the candidate in the answer script.	Invalidating the examinations of all the theory and practical subjects of the current semester and all the arrears –subjects registered by the candidate.
19.	The candidate possessing the answer script of another candidate.	
20.	The candidate passing his /her answer script to another candidate.	
21.	Involved in any one or more of the malpractices of serial no. 8 to 21 for the second or subsequent times.	Invalidating the examinations of all the theory and practical courses of the current semester and all the arrears- courses registered by the candidate. **Additional Punishment :** i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for one year i.e., for two subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period. ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears - subjects for two subsequent semesters.
22.	The candidate substituting an answer sheets prepared outside the examination hall for the one already distributed to the candidate.	

<table>
<tr><td>23.</td><td>The candidate indulge in any disruptive conduct including, but not limited to, shouting, assault of invigilator, officials or students using abusive and /or threatening language, destruction of property.</td><td rowspan="3">Invalidating the examinations of all the theory and practical courses of the current semester and all the arrears- courses registered by the candidate.
Additional Punishment :
i. If the candidate has not completed the programme, he/she is debarred from continuing his/her studies for two years i.e., for four subsequent semesters. However the student is permitted to appear for the examination in all the arrears-subjects during the debarred period.
ii. If the candidate has completed the programme, he/she is prevented from writing the examinations of the arrears - courses for four subsequent semesters.</td></tr>
<tr><td>24.</td><td>The candidate harass or engage others to harass on his/her behalf an invigilator, official, witnesses or any other person in relation to an irregularity by making telephone calls, visits, mails or by any other means.</td></tr>
<tr><td>25.</td><td>Candidate possessing any firearm/weapon inside the examination hall.</td></tr>
<tr><td>26.</td><td>Cases of Impersonation</td><td>i. Handing over the impersonator to the police with a complaint to take appropriate action against the person involved in the impersonation by the Chief Supt.
If a student is found to impersonate a ‘bonafide student’, the impersonating student is debarred from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme.
Debarring the ‘bonafide student’ for whom the impersonation was done from continuing his/her studies and writing the examinations permanently. He/she is not eligible for any further admission to any programme .</td></tr>
</table>

APPENDIX - IV

Process to Consider the Application for Revocation of Detainment

The process to consider the application for revocation of detainment on account of lack of attendance in 3 or more courses, due to genuine reasons (viz. sports participation, NCC, Medical Grounds etc.) is as follows :

The student submits an application for consideration via a request letter to the CoE,not later than 3 days from the last working day, along with the HoD's recommendation, Class Advisor's report and Mentor's recommendation. A committee consisting of the Principal, CoE, HoD (Respective Department) and HoD's-2 from departments other than the student's own. The committee shall meet within 4 working days,to consider the case. Stakeholders may be called to be present in the meeting as may be required, and Decision arrived at.The decision approved by Principal shall be final.

APPENDIX - V

Academic Evaluation Committee (AEC)

The committee includes the Principal, CoE, HoD concerned. The committee meets to carry out business related to academic matters which require central decision making and approval viz. retest approval of missed CIA, addressing the feedback collected from the various departments' class committee meetings.

Department Evaluation Committee (DEC)

The committee includes HoD (need basis), and a few faculty members of the department from various levels. The committee meets to carry out business related to academic matters that can be addressed within the department viz. course equivalence of common courses for readmitted students; approval of new courses to be offered by the department; consider and approve the credit equivalence of courses offered by industry, review the course offerings; consider the merit of applications involving lack of attendance in PE/OE courses to take up another PE or OE; approve CIAM only courses every semester; approve scheme of assessment for each course; Approval for and Mapping credits of certification courses; approval of list of nationally or internationally recognized professional certification courses with prometric testing.

Curriculum

KIT - Kalaignarkarunanidhi Institute of Technology

An Autonomous Institution

Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai
Accredited by NAAC with 'A' GRADE & NBA (AERO, CSE, ECE, EEE, MECH & MBA)
An ISO 9001 : 2015 Certified Institution, Coimbatore - 641 402.

DEPARTMENT OF MECHANICAL ENGINEERING

M.E. - ENGINEERING DESIGN

Conceptual Frame work
(For Students admitted from the Academic Year 2023-24 and onwards)

Semester	Level of Course	Hrs. / Week	No of Courses	Range of Credits / Courses	Total Credits
A - Foundation Courses					
I	Basic Science (BS)	4	1	4	4
B - Professional Core Courses					
I to II	Professional Core (PC)	34	11	2 - 4	31
C - Elective Courses					
I to III	Professional Elective (PE)	15	5	3	15
III	Open Elective (OE)	3	1	3	3
D - Project Work Courses					
II to IV	Project Work (PW)	63	3	2 - 12	20
Total Credit					**73**

Approved by BoS Chairman

Curriculum and Scheme of Assessment

(For Students admitted from the Academic Year 2023-24 and onwards)

SEMESTER - I

Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
M23MAT106	Applied Mathematics for Engineers	**BS**	4	3	1	0	**4**	40	60	100
M23EDT101	Computer Applications in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT102	Quality Concepts in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT103	Advanced Finite Element Analysis	**PC**	4	3	1	0	**4**	40	60	100
M23EDT104	Advanced Machine Tool Design	**PC**	3	3	0	0	**3**	40	60	100
	Professional Elective I	**PE**	3	3	0	0	**3**	40	60	100
Practical										
M23EDP101	CAD Laboratory	**PC**	4	0	0	4	**2**	60	40	100
M23EDP102	Advanced Analysis and Simulation Laboratory	**PC**	4	0	0	4	**2**	60	40	100
Total credits to be earned							**24**			

SEMESTER - II

Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
M23EDT201	Tribology in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT202	Mechanical Behavior of Materials	**PC**	3	3	0	0	**3**	40	60	100
M23EDT203	Integrated Mechanical Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT204	Vibration Analysis and Control	**PC**	3	3	0	0	**3**	40	60	100
	Professional Elective - II	**PE**	3	3	0	0	**3**	40	60	100
	Professional Elective - III	**PE**	3	3	0	0	**3**	40	60	100
Practical										
M23EDP201	Vibration Laboratory	**PC**	4	0	0	4	**2**	60	40	100
M23EDP202	Design Project	**PW**	4	0	0	4	**2**	40	60	100
Total credits to be earned							**22**			

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SEMESTER - III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
	Professional Elective - IV	**OE**	3	3	0	0	**3**	40	60	100
	Professional Elective - V	**PE**	3	3	0	0	**3**	40	60	100
	Professional Elective - VI	**PE**	3	3	0	0	**3**	40	60	100
Practical										
M23EDP301	Project Work Phase - I	**PW**	20	0	0	12	**6**	60	40	100
Total credits to be earned							**15**			

SEMESTER - IV										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Practical										
M23EDP401	Project Work Phase - II	**PW**	40	0	0	24	**12**	60	40	100
Total credits to be earned							**12**			

BASIC SCIENCE (BS)										
SEMESTER – I										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23MAT103	Applied Mathematics For Engineers	**PC**	4	3	1	0	**4**	40	60	100

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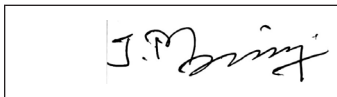
PROFESSIONAL CORE (PC)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
Theory										
M23EDT101	Computer Applications in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT102	Quality Concepts in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT103	Advanced Finite Element Analysis	**PC**	4	3	1	0	**4**	40	60	100
M23EDT104	Advanced Machine Tool Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT201	Tribology in Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT202	Mechanical Behavior of Materials	**PC**	3	3	0	0	**3**	40	60	100
M23EDT203	Integrated Mechanical Design	**PC**	3	3	0	0	**3**	40	60	100
M23EDT204	Vibration Analysis and Control	**PC**	3	3	0	0	**3**	40	60	100
Practical										
M23EDP101	CAD Laboratory	**PC**	3	0	0	3	**2**	60	40	100
M23EDP102	Advanced Analysis and Simulation Laboratory	**PC**	3	0	0	3	**2**	60	40	100
M23EDP201	Vibration Laboratory	**PC**	3	0	0	3	**2**	60	40	100

PROFESSIONAL ELECTIVES (PE)										
SEMESTER – I										
ELECTIVE – I										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23EDE101	Optimization Techniques in Design	**PE**	3	3	0	0	**3**	40	60	100
M23EDE102	Research Methodology, IPR and Patents	**PE**	3	3	0	0	**3**	40	60	100
M23EDE103	Engineering Fracture Mechanics	**PE**	3	3	0	0	**3**	40	60	100
M23EDE104	Additive Manufacturing and Tooling	**PE**	3	3	0	0	**3**	40	60	100
M23EDE105	Information Analytics	**PE**	3	3	0	0	**3**	40	60	100



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SEMESTER – II										
ELECTIVE – II & III										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23EDE201	Artificial Intelligence and Machine Learning	PE	3	3	0	0	3	40	60	100
M23EDE202	Modal Analysis of Mechanical Systems	PE	3	3	0	0	3	40	60	100
M23EDE203	Advanced Metal Forming Techniques	PE	3	3	0	0	3	40	60	100
M23EDE204	Surface Engineering	PE	3	3	0	0	3	40	60	100
M23EDE205	Mechanisms Design and Simulation	PE	3	3	0	0	3	40	60	100
M23EDE206	Design of Material Handling Systems	PE	3	3	0	0	3	40	60	100
M23EDE207	Bio Materials	PE	3	3	0	0	3	40	60	100
M23EDE208	Mechanical Measurements and Analysis	PE	3	3	0	0	3	40	60	100
M23EDE209	Computational Fluid Dynamics	PE	3	3	0	0	3	40	60	100
M23EDE210	Design of Hybrid and Electric Vehicles	PE	3	3	0	0	3	40	60	100

Approved by BoS Chairman

SEMESTER – III										
ELECTIVE – IV & V										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23EDE301	Advanced strength of materials	PE	3	3	0	0	3	40	60	100
M23EDE302	Design of Hydraulic and Pneumatic Systems	PE	3	3	0	0	3	40	60	100
M23EDE303	Design for X	PE	3	3	0	0	3	40	60	100
M23EDE304	Product Design for Sustainability	PE	3	3	0	0	3	40	60	100
M23EDE305	Green Manufacturing Practices	PE	3	3	0	0	3	40	60	100
M23EDE306	Design for Manufacture, Assembly and Environments	PE	3	3	0	0	3	40	60	100
M23EDE307	Engineering Biomechanics	PE	3	3	0	0	3	40	60	100
M23EDE308	Composite Materials and Mechanics	PE	3	3	0	0	3	40	60	100
M23EDE309	Design for Internet of Things	PE	3	3	0	0	3	40	60	100
M23EDE310	Human Factors Engineering in Product Design	PE	3	3	0	0	3	40	60	100
M23EDE311	Product Lifecycle Management	PE	3	3	0	0	3	40	60	100
M23EDE312	Cost Management of Engineering Projects	PE	3	3	0	0	3	40	60	100

PROJECT WORK (PW)										
Course Code	Course Name	CT	Instructional Hours					Assessment		
			CP	L	T	P	C	CIA	ESE	Total
M23EDP202	Design Project	PW	3	0	0	6	2	40	60	100
M23EDP301	Project Work Phase - I	PW	20	0	0	12	6	40	60	100
M23EDP401	Project Work Phase - II	PW	40	0	0	24	12	40	60	100

Approved by BoS Chairman

Semester - I

M.E - E.D	M23MAT106 - APPLIED MATHEMATICS FOR ENGINEERS	L	T	P	C
		3	1	0	4

Course Objectives	
1.	This course is designed to enrich the knowledge in various advanced mathematical techniques such as matrix theory, calculus of variations, probability and random variables, Laplace transforms and Fourier transforms.
2.	The fundamental concepts in these areas will be more useful for the students to model the engineering problems and solving them by applying these methods.
3.	Mathematics fundamental necessary to formulate, solve and analyze engineering problems.
4.	An understanding of Linear Algebra through matrices.
5.	An understanding of Complex integration.

UNIT - I	MATRIX THEORY	12

The Cholesky decomposition - Generalized Eigenvectors - Canonical basis - QR factorization - Least squares method - Singular value decomposition

UNIT - II	CALCULUS OF VARIATIONS	12

Concept of variation and its properties – Euler's equation – Functional dependent on first and higher order derivatives – Functional dependent on functions of several independent variables – Variational problems with moving boundaries – Isoperimetric problems - Direct methods : Ritz and Kantorovich methods

UNIT - III	ONE DIMENSIONAL RANDOM VARIABLES	12

Random variables - Probability function – Moments – Moment generating functions and their properties – Binomial, Poisson, Geometric, Uniform, Exponential, Gamma and Normal distributions

UNIT - IV	LAPLACE TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS	12

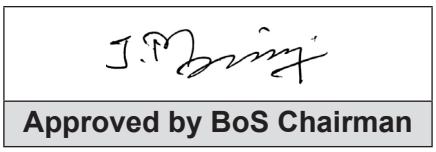
Laplace transform - Definitions - Properties – Transform error function - Bessel's function - Dirac delta function - Unit step functions – Convolution theorem – Inverse Laplace transform: Complex inversion formula – Solutions to partial differential equations: Heat equation - Wave equation

Approved by BoS Chairman

UNIT - V	FOURIER TRANSFORM TECHNIQUES FOR PARTIAL DIFFERENTIAL EQUATIONS	12
Fourier transform: Definitions – Properties – Transform of elementary functions – Dirac delta function – Convolution theorem – Parseval's identity – Solutions to partial differential equations: Heat equation - Wave equation - Laplace and Poisson's equations		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Apply various methods in matrix theory to solve system of linear equations.
CO2	Solve maximizing and minimizing the functional that occur in mechanical engineering disciplines.
CO3	Solve moments, MGF and different types of distributions problems.
CO4	Apply Laplace transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations.
CO5	Apply Fourier transforms to initial value, initial–boundary value and boundary value problems in Partial Differential Equations.

Reference Books	
1.	Andrews L.C. and Shivamoggi, B. "Integral Transforms for Engineers", Prentice Hall of India Pvt. Ltd., New Delhi,2003.
2.	Bronson, R. "Matrix Operations", Schaum's outline series, McGraw Hill, 2nd Edition, 2011.
3.	James, G., "Advanced Modern Engineering Mathematics ", Pearson Education, 3rd Edition, 2004.
4.	Johnson, R.A., Miller, I and Freund J., "Miller and Freund's Probability and Statistics for Engineers", Pearson Education, Asia, 8th Edition, 2015.
5.	O'Neil, P.V., "Advanced Engineering Mathematics ", Thomson Asia Pvt. Ltd., Singapore,2011.
6.	SankaraRao, K., "Introduction to Partial Differential Equations", Prentice Hall of India Pvt. Ltd., New Delhi, 2011.



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M.E - E.D	M23EDT101 - COMPUTER APPLICATIONS IN DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the Fundamentals of CAD/CAM.
2.	To evaluate and refine the design using computer simulations.
3.	To understand the solid modeling techniques.
4.	To visualize the visual realism using software package.
5.	To understand the assembly and data exchange process.

UNIT - I	INTRODUCTION TO COMPUTER GRAPHICS FUNDAMENTALS	9

Output primitives (points, lines, curves etc.,), 2-D & 3-D transformation (Translation, scaling, rotation) windowing - view ports - clipping transformation

UNIT - II	CURVES AND SURFACES MODELING	9

Introduction to curves - Analytical curves: line, circle and conics – synthetic curves: Hermite cubic spline- Bezier curve and B-Spline curve – curve manipulations. Introduction to surfaces - Analytical surfaces: Plane surface, ruled surface, surface of revolution and tabulated cylinder – synthetic surfaces: Hermite bi-cubic surface- Bezier surface and B-Spline surface- surface manipulations

UNIT - III	NURBS AND SOLID MODELING	9

NURBS- Basics- curves, lines, arcs, circle and bi linear surface. Regularized Boolean set operations - primitive instancing - sweep representations - boundary representations – constructive solid Geometry - comparison of representations - user interface for solid modeling

UNIT - IV	VISUAL REALISM	9

Hidden – Line – Surface – solid removal algorithms shading – coloring. Introduction to parametric and variational geometry based software's and their principles creation of prismatic and lofted parts using these packages

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UNIT - V	ASSEMBLY OF PARTS AND PRODUCT DATA EXCHANGE	9
Assembly modeling - interferences of positions and orientation - tolerances analysis – mass property calculations - mechanism simulation. Graphics and computing standards - GKS- Bitmaps - Open GL Data Exchange standards - IGES - STEP - CALS - DXF - Communications standards - WAN - LAN		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the fundamentals of computer graphics.
CO2	Apply different techniques for geometric modeling.
CO3	Apply different algorithm to create prismatic and lofted parts.
CO4	Outline tolerance analysis and mass property calculations.
CO5	Explain data exchange standards and communication standards.

Text Books	
1.	Ibrahim Zeid Mastering CAD/CAM – McGraw Hill, International Edition, 2010.
2.	David F. Rogers, James Alan Adams “Mathematical elements for computer graphics” fifth edition, Tata McGraw-Hill edition.2011.

Reference Books	
1.	Donald Hearn and M. Pauline Baker “Computer Graphics”, Prentice Hall, Inc., 2013.
2.	Foley, Wan Dam, Feiner and Hughes – Computer graphics principles & practices, Pearson Education – 2010.
3.	William M Neumann and Robert F. Sproull “Principles of Computer Graphics”, McGraw Hill Book – 2011.

Approved by BoS Chairman

M.E - E.D	M23EDT102 - QUALITY CONCEPTS IN DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on various concepts in engineering design, material selection and manufacturing methods.
2.	To learn the principles of implementing quality in a product or services using different tools
3.	To enhance the quality of product by use of failure mode effect analysis and implement methods to uphold the status of six sigma
4.	To develop a robust product or service using various strategies of design of experiments
5.	To maintain the quality of the product by use of statistical tools and enforce methods to improve the reliability of a product

UNIT - I	DESIGN FUNDAMENTALS, METHODS AND MATERIAL SELECTION	9

Morphology of Design – The Design Process – Computer Aided Engineering – Concurrent Engineering – Competition Bench Marking – Creativity – Theory of Problem solving (TRIZ) – Value Analysis - Design for Manufacture, Design for Assembly – Design for casting, Forging, Metal Forming, Machining and Welding

UNIT - II	DESIGN FOR QUALITY	9

Identification of customer needs - customer requirements - Quality Function Deployment - Product Design Specifications - Human Factors in Design – Ergonomics and Aesthetics. Societal consideration - Contracts – Product liability – Protecting intellectual property – Legal and ethical domains – Codes of ethics – Ethical conflicts – Environment responsible design - future trends in interaction of Engineering with society

UNIT - III	FAILURE MODE EFFECTS ANALYSIS AND DESIGN FOR SIX SIGMA	9

Basic methods : Refining geometry and layout, general process of product embodiment - Embodiment checklist - **Advanced methods :** systems modeling, mechanical embodiment principles - MEA method - linking fault states to systems modeling - Basis of SIX SIGMA – Project selection for SIX SIGMA - SIX SIGMA problem solving - SIX SIGMA in service and small organizations - SIX SIGMA and lean production – Lean SIX SIGMA and services

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UNIT - IV	DESIGN OF EXPERIMENTS	9
Importance of Experiments, Experimental Strategies, Basic principles of Design, Terminology, ANOVA, Steps in Experimentation, Sample size, Single Factor experiments - Completely Randomized design, Randomized Block design, Statistical Analysis, Multifactor experiments - Two and three factor full Factorial experiments, 2K factorial Experiments, Confounding and Blocking designs, Fractional factorial design, Taguchi's approach - Steps in experimentation, Design using Orthogonal Arrays, Data Analysis, Robust Design- Control and Noise factors, S/N ratios		

UNIT - V	STATISTICAL CONSIDERATION AND RELIABILITY	9
Frequency distributions and Histograms - Run charts – stem and leaf plots - Pareto diagrams - Cause and Effect diagrams - Box plots - Probability distribution - Statistical Process control – Scatter diagrams – Multivariable charts – Matrix plots and 3-D plots - Reliability - Survival and Failure - Series and parallel systems - Mean time between failure - Weibull distributions		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Apply fundamentals of design process and material selection for developing a quality product
CO2	Apply the quality concepts to develop a robust product
CO3	Perform Failure Mode Effect Analysis on a product and use six sigma principles to enhance its quality
CO4	Apply different experimental design methods in product development
CO5	Implement various statistical tools to improve its quality and reliability

Text Books	
1.	Dieter, George E., "Engineering Design - A Materials and Processing Approach", McGraw Hill, International Editions, Singapore, 2010.
2.	Fundamentals of Quality control and improvement 5th edition, Amitava Mitra, Pearson Education Asia, 2012.

Reference Books	
1.	Montgomery, D.C., Design and Analysis of experiments, John Wiley and Sons, 2013.
2.	Phillip J.Rose, Taguchi techniques for quality engineering, McGraw Hill, 2010.
3.	Product Design and Development, Karl t. Ulrich, Steven D. Eppinger, TataMcgraw Hill 5th Edition, 2013.

Approved by BoS Chairman

M.E - E.D	M23EDT103 - ADVANCED FINITE ELEMENT ANALYSIS	L	T	P	C
		3	1	0	4

Course Objectives	
1.	To apply the finite element procedure to solve 1D and 2D structural and heat transfer problems.
2.	To describe the finite element formulation of structural and heat transfer problems using 2D quadratic.
3.	To solve problems in axisymmetric elements.
4.	To demonstrate the Iso-parametric formulation.
5.	To solve structural dynamics problems using 1D elements.

UNIT - I	INTRODUCTION	13

Relevance of finite element analysis in design – Modeling and discretization Interpolation, elements, nodes and degrees-of-freedom-applications of FEA One-Dimensional Elements and Computational Procedures : Bar element – beam element – bar and beam elements of arbitrary orientation – assembly of elements – properties of stiffness matrices - boundary conditions solution of equations - mechanical loads and stresses - thermal loads and stresses - example problems

UNIT - II	TWO DIMENSIONAL PROBLEMS	13

Interpolation and shape functions - element matrixes - triangular elements - CST - LST - quadratic triangular elements - bilinear rectangular elements - quadratic rectangular elements - theory of elasticity - plane stress - plane strain - Heat transfer - torsion problems

UNIT - III	AXISYMMETRIC PROBLEMS	11

Axisymmetric formulation - element stiffens matrix and force vector - body force and temperature effects - stress calculations boundary conditions - Applications to cylindrical under internal or external pressure - rotating disc. Non liner problems - material non linearity - geometric nonlinearity - large displacements

UNIT - IV	ISOPARAMETRIC ELEMENTS	11

Introduction - bilinear quadrilateral elements – quadratic quadrilaterals – hexahedral elements – Numerical Integration – gauss quadrature - static condensation – load considerations – stress calculations – examples of 2D and 3D applications

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UNIT - V	FLUID MECHANICS AND HEAT TRANSFER	12
Governing Equations of Fluid Mechanics – Solid structure interaction - Inviscid and Incompressible Flow – Potential Formulations – Slow Non-Newtonian Flow – Metal and Polymer Forming – Navier Stokes Equation – Steady and Transient Solution		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Apply the finite element procedure to solve 1D and 2D structural and heat transfer problems.
CO2	Explain the finite element formulation of structural and heat transfer problems using 2D quadratic.
CO3	Solve problems in axisymmetric elements.
CO4	Demonstrate the Iso-parametric formulation.
CO5	Solve structural dynamics problems using1D elements.

Text Books	
1.	Cook, Robert Davis et al “Concepts and Applications of Finite Element Analysis “, Wiley Student Edition, 2017.
2.	J.N. Reddy, " An Introduction to the Finite Element Method" , McGraw Hill, 3rd edition, Nov 2005.

Reference Books	
1.	Segerlind L.J., “Applied Finite Element Analysis”, John Wiley, 2008.
2.	George R Buchaman, “ Schaum’s Outline of Finite Element Analysis”, McGraw Hill Company, 2010.
3.	R3 - Singiresu S. Rao, " Finite Element Analysis ", Butterworth-Heinemann Ltd; 5th Revised edition, December 2010.

Approved by BoS Chairman

M.E - E.D	M23EDT104 – ADVANCED MACHINE TOOL DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Selecting the different machine tool mechanisms.
2.	Designing the Multi speed Gear Box and feed drives.
3.	Designing the machine tool structures.
4.	Designing the guide ways and power screws.
5.	Designing the spindles and bearings.

UNIT - I	INTRODUCTION TO MACHINE TOOL DESIGN	9

Introduction to Machine Tool Drives and Mechanisms, Auxiliary Motions in Machine Tools, Kinematics of Machine Tools, Motion Transmission

UNIT - II	REGULATION OF SPEEDS AND FEEDS	9

Aim of Speed and Feed Regulation, Stepped Regulation of Speeds, Multiple Speed Motors, Ray Diagrams and Design Considerations, Design of Speed Gear Boxes, Feed Drives, Feed Box Design

UNIT - III	DESIGN OF MACHINE TOOL STRUCTURES	9

Functions of Machine Tool Structures and their Requirements, Design for Strength, Design for Rigidity, Materials for Machine Tool Structures, Machine Tool Constructional Features, Beds and Housings, Columns and Tables, Saddles and Carriage

UNIT - IV	DESIGN OF GUIDEWAYS AND POWER SCREWS	9

Functions and Types of Guideways, Design of Guideways, Design of Aerostatic Slide ways, Design of Anti-Friction Guideways, Combination Guideways, Design of Power Screws

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UNIT - V	DESIGN OF SPINDLES AND SPINDLE SUPPORT	9
Functions of Spindles and Requirements, Effect of Machine Tool Compliance on Machining Accuracy, Design of Spindles, Antifriction Bearings. Dynamics of Machine Tools: Machine Tool Elastic System, Static and Dynamic Stiffness		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Select the different machine tool mechanisms.
CO2	Design the Multi speed Gear Box and feed drives.
CO3	Design the machine tool structures.
CO4	Design the guideways and power screws.
CO5	Design the spindles and bearings.

Reference Books	
1.	N.K. Mehta, Machine Tool Design and Numerical Control, TMH, New Delhi, 3rd edition 2012.
2.	G.C. Sen and A. Bhattacharya, Principles of Machine Tools, New Central Book Agency, 2015.
3.	K Pal, S. K. Basu, “Design of Machine Tools”, 6th Edition. Oxford IBH, 2014.
4.	N. S. Acherkhan, “Machine Tool Design”, Volume 2 University Press of the Pacific, 2000.
5.	F. Koenigsberger, Machine Tool Structures, Pergamon Press,1970.

Approved by BoS Chairman

M.E.	M23EDP101 - CAD LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To Sketch the complex components in orthographic and isometric views using CAD packages.
2.	To illustrate assembly drawing of various machine components.
3.	To Practice the method, meshing, and analysis of simple Components. An understanding of Linear Algebra through matrices.
4.	Increase ability to communicate with people.
5.	Prepare the student for future Engineering positions.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	Preparation of 2-D drawings Orthographic views of standard machine components.
2.	Brackets, V Blocks, Screw threads and threaded fasteners.
3.	3D part modeling – protrusion, cut, sweep, draft, loft, blend, rib.
4.	Preparation of assembled drawing of standard machine components.
5.	Exercises in modeling using Simulation feature in packages like CREO / SOLID EDGE / SOLIDWORKS / CATIA etc.
6.	Exercises in Modeling and Analysis of simple Components using Parametric and feature based Packages like PRO-E / SOLID EDGE / CATIA / ANSYS / NASTRAN etc.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Construct the complex components in orthographic and isometric views using CAD packages.
CO2	Illustrate assembly drawing of various machine components.
CO3	Make use of the method, meshing, and analysis of simple Components.

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CO4	Develop and sketches to engineered drawings will increase.
CO5	Make use of architectural and engineering scales will increase.

LIST OF EQUIPMENT FOR A BATCH OF 18 STUDENTS		
Sl. No.	**NAME OF THE EQUIPMENT**	**Qty.**
1.	Computers with necessary accessories	18
2.	Assembly drawings using any 2D / 3D CAD Software	18
3.	Printer	1

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M.E.	M23EDP102 - ADVANCED ANALYSIS AND SIMULATION LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	To give exposure to software tools needed to analyze engineering problems.
2.	To expose the students to different applications of simulation and analysis tools.
3.	To impart the fundamental knowledge on using various analytical tools like ANSYS, FLUENT, etc., for Engineering Simulation.
4.	To know various fields of engineering where these tools can be effectively used to improve the output of a product.
5.	To impart knowledge on how these tools are used in Industries by solving some real time problems using these tools.

List of Experiments	
Expt. No.	**Description of the Experiments**
A. Simulation	
1.	MATLAB basics, dealing with matrices, Graphing-Functions of one variable and two variables
2.	Use of Mat lab to solve simple problems in vibration
3.	Mechanism Simulation using Multi body Dynamic software
B. Analysis	
1.	Force and Stress analysis using link elements in Trusses, cables etc.
2.	Stress and deflection analysis in beams with different support conditions.
3.	Stress analysis of flat plates and simple shells.
4.	Stress analysis of axi – symmetric components.
5.	Thermal stress and heat transfer analysis of plates.

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6.	Thermal stress analysis of cylindrical shells.
7.	Vibration analysis of spring-mass systems.
8.	Model analysis of Beams.
9.	Harmonic, transient and spectrum analysis of simple systems.
	Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Construct the complex components and simulate the experiments.
CO2	Illustrate the components and analyze to meet the global requirements.
CO3	Make use of the tools like ANSYS or FLUENT in solving real time problems and day to day problems.
CO4	Make use of these tools for any engineering and real time applications.
CO5	Acquire knowledge on utilizing these tools for a better project in their curriculum as well as they will be prepared to handle industry problems.

LIST OF EQUIPMENT FOR A BATCH OF 18 STUDENTS

Sl. No.	NAME OF THE EQUIPMENT	Qty.
1.	Computers with necessary accessories	18
2.	MAT Lab and ANSYS Software	18
3.	Printer	1

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Semester - II

M.E - E.D	M23EDT201 - TRIBOLOGY IN DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge in the friction, wear and lubrication aspects of machine components.
2.	To understand the material properties which influence the tribological characteristics of surfaces.
3.	To understand the analytical behavior of different types bearings and design of bearing based on analytical / theoretical approach.
4.	To study about the Topographic measurements.
5.	To study about vibration measurements.

UNIT - I	SURFACES, FRICTION AND WEAR	9

Topography of Surfaces – Surface features – Surface interaction – Theory of Friction – Sliding and Rolling Friction, Friction properties of metallic and non-metallic materials – friction in extreme conditions – wear, types of wear – mechanism of wear – wear resistance materials – surface treatment – Surface modifications – surface coatings

UNIT - II	LUBRICATION THEORY	9

Lubricants and their physical properties lubricants standards – Lubrication Regimes Hydrodynamic lubrication – Reynolds Equation, Thermal, inertia and turbulent effects – Elasto hydrodynamic and plasto hydrodynamic and magneto hydrodynamic lubrication – Hydro static lubrication – Gas lubrication

UNIT - III	DESIGN OF FLUID FILM BEARINGS	9

Design and performance analysis of thrust and journal bearings – Full, partial, fixed and pivoted journal bearings design – lubricant flow and delivery – power loss, Heat and temperature rotating loads and dynamic loads in journal bearings – special bearings – Hydrostatic Bearing design

UNIT - IV	ROLLING ELEMENT BEARINGS	9

Hours Geometry and kinematics – Materials and manufacturing processes – contact stresses – Hertzian stress equation – Load divisions – Stresses and deflection – Axial loads and rotational effects, Bearing life capacity and variable loads – ISO standards – Oil films and their effects – Rolling Bearings Failures

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UNIT - V	TRIBO MEASUREMENT IN INSTRUMENTATION	9
Surface Topography measurements – Electron microscope and friction and wear measurements – Laser method – instrumentation - International standards – Bearings performance measurements – Bearing vibration measurement		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Demonstrate the basic concepts of friction, lubrication and wear processes.
CO2	Perform analysis in fluid film bearings.
CO3	Categorize the design aspects and kinematics of rolling element bearings.
CO4	Explain the concepts of tribology instrumentation.
CO5	List the vibration measurement techniques of bearings.

Text Books	
1.	Ghosh M.K, Theory of lubrbication, 2017.
2.	Mihirkumar josh Fundamentals of fluid film lubrication, Mcgrawhill, 2014.

Reference Books	
1.	Mohammad NurulHoque “Vibration analysis of rolling element bearings”, 2011.
2.	A.K. Sawney, “Electronic measurement and instrumentation”, 2015.

Approved by BoS Chairman

M.E - E.D	M23EDT202 - MECHANICAL BEHAVIOR OF MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Analyzing the different strengthening and failure mechanism of the metals
2.	Applying the effects of metallurgical parameters in the materials design
3.	Analyzing the relationship between the selection of materials and processing
4.	Developing the novel material through understanding the properties of the existing metallic materials
5.	Analyzing the different materials used in the engineering applications

UNIT - I	BASIC CONCEPTS OF MATERIAL BEHAVIOR	10

Elasticity in metals and polymers – Strengthening mechanisms, work hardening, solid solutioning, grain boundary strengthening, poly phase mixture, precipitation, particle, fibre and dispersion strengthening. Effect of temperature, strain and strain rate on plastic behaviour – Super plasticity – Griffith's theory, – Ductile, brittle transition in steel – High temperature fracture, creep – Larson Miller parameter – Deformation and fracture mechanism maps

UNIT - II	BEHAVIOUR UNDER DYNAMIC LOADS AND DESIGN APPROACHES	10

Stress intensity factor and fracture toughness – Fatigue, low and high cycle fatigue test, crack initiation and propagation mechanisms and Paris law.- Safe life, Stress life, strain-life and fail - safe design approaches -Effect of surface and metallurgical parameters on fatigue – Fracture of non-metallic materials – Failure analysis, sources of failure, procedure of failure analysis

UNIT - III	SELECTION OF MATERIALS	10

Motivation for selection, cost basis and service requirements – Selection for mechanical properties, strength, toughness, fatigue and creep – Selection for surface durability corrosion and wear resistance – Relationship between materials selection and processing – Case studies in materials selection with relevance to aero, auto, marine, machinery and nuclear applications – Computer aided materials selection

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UNIT - IV	NONMETALLIC MATERIALS	7
Composite materials, ceramics, plastics -Introduction, an overview of processing, their characteristic features, types and applications		

UNIT - V	MODERN MATERIALS AND ALLOYS	8
Super alloys - Refractory metals - Shape memory alloys - Dual phase steels, Micro alloyed, High strength low alloy steel, Transformation induced plasticity (TRIP) steel, Maraging steel – SMART materials, Metallic glass – Quasi crystal and Nano crystalline materials., metal foams		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Analyze the different strengthening and failure mechanism of the metals
CO2	Apply the effects of metallurgical parameters in the materials design
CO3	Analyze the relationship between the selection of materials and processing
CO4	Develop the novel material through understanding the properties of the existing metallic materials
CO5	Analyze the different materials used in the engineering applications

Text Books	
1.	Callister W.D. (2015) "Material Science and Engineering- An introduction", Wiley –Eastern.
2.	Raghavan, V., (2003) "Physical Metallurgy", Prentice Hall of India.

Reference Books	
1.	Ashby M.F., materials selection in Mechanical Design 2nd Edition, Butter worth 2017.
2.	Charles, J.A., Crane, F.A.A. and Fumess, J.A.G., Selection and use of engineering materials, (34th edition), Butterworth-Heiremann, 2000.
3.	Flinn, R.A., and Trojan, P.K., Engineering Materials and their Applications, (4th Edition) Jaico, 2010.

Approved by BoS Chairman

M.E - E.D	M23EDT203 - INTEGRATED MECHANICAL DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To learn to use standard practices and standard data.
2.	To gain knowledge on the principles and procedure for the design of gears and gear boxes
3.	To understand the standard procedure for designing brakes.
4.	To know the integrated design procedure of different machine elements for mechanical applications

UNIT - I	FUNDAMENTALS AND DESIGN OF SHAFTS	15

Phases of design – Standardization and interchangeability of machine elements - Process and Function Tolerances – Individual and group tolerances – Selection of fits for different design situations – Design for assembly and modular constructions – Concepts of integration – BIS, ISO,DIN, BS, ASTM Standards. Oblique stresses – Transformation Matrix – Principal stresses – Maximum shear stress - Theories of Failure – Ductile vs. brittle component design - Analysis and Design of shafts for different applications – integrated design of shaft, bearing and casing – Design for rigidity

UNIT - II	DESIGN OF GEARS AND GEAR BOXES	15

Principles of gear tooth action – Gear correction – Gear tooth failure modes – Stresses and loads – Component design of spur, helical, bevel and worm gears – Design for sub assembly – Integrated design of speed reducers and multi-speed gearboxes – application of software packages

UNIT - III	BRAKES	12

Dynamics and thermal aspects of vehicle braking – Integrated design of brakes for machine tools, automobiles and mechanical handling equipments

UNIT - IV	INTEGRATED DESIGN	18

Integrated Design of systems consisting of shaft, bearings, springs, motor, gears, belt, rope, chain, pulleys, Cam & Follower, flywheel etc. Example - Design of Elevators, Escalators Gear Box, Valve gear Mechanisms, Machine Tools

Total Instructional hours : 60

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Course Outcomes : Students will be able to	
CO1	Design shafts for various applications.
CO2	Design gears and gear boxes for power transmission
CO3	Desing brakes for machine tools and automobiles.
CO4	Design of integrated mechanical system for machine tools, power transmission

Reference Books	
1.	Newcomb, T.P. and Spur, R.T., “Automobile Brakes and Braking Systems”, Chapman and Hall, 2nd Edition, 2010.
2.	Juvinall, RL.C., “Fundamentals of Machine Component Design”, John Wiley, 2012.
3.	Maitra G.M., “Hand Book of Gear Design”, Tata McGraw Hill, 2016.
4.	Shigley, J.E., “Mechanical Engineering Design”, McGraw Hill, 2015.

Approved by BoS Chairman

M.E - E.D	M23EDT204 - VIBRATION ANALYSIS AND CONTROL	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the Fundamentals of Vibration and its practical applications.
2.	To understand the working principle of various vibration measuring instruments.
3.	To understand the operations of various vibration measuring instruments.
4.	To understand the various Vibration control strategies.
5.	To understand the experimental methods in vibration analysis.

UNIT - I	FUNDAMENTALS OF VIBRATION	11

Review of Single degree freedom systems – Response to arbitrary periodic Excitations – Duhamel's Integral – Impulse Response function – Virtual work – Lagrange's equation – Single degree freedom forced vibration with elastically coupled viscous dampers – System Identification from frequency response – Transient Vibration – Laplace transformation formulation

UNIT - II	TWO DEGREE FREEDOM SYSTEM	11

Free vibration of spring-coupled system – mass coupled system – Vibration of two degree freedom system – Forced vibration – Vibration Absorber – Vibration isolation

UNIT - III	MULTI - DEGREE FREEDOM SYSTEM	15

Normal mode of vibration – Flexibility Matrix and Stiffness matrix – Eigen values and eigen vectors – orthogonal properties – Modal matrix - Modal Analysis – Forced Vibration by matrix inversion – Modal damping in forced vibration – Numerical methods for fundamental frequencies

UNIT - IV	VIBRATION OF CONTINUOUS SYSTEM	11

Systems governed by wave equations – Vibration of strings – vibration of rods – Euler Equation for Beams – Effect of Rotary inertia and shear deformation – Vibration of plates

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UNIT - V	EXPERIMENTAL METHODS IN VIBRATION ANALYSIS	12
Vibration Analysis Overview - Experimental Methods in Vibration Analysis - Vibration Measuring Instruments - Selection of Sensors - Accelerometer Mountings - Vibration Exciters - Mechanical, Hydraulic, Electromagnetic and Electrodynamics - Frequency Measuring Instruments - System Identification from Frequency Response -Testing for resonance and mode shapes		
		Total Instructional hours : 60

Course Outcomes : Students will be able to	
CO1	Develop the equation of motion for single degree of freedom by using various methods.
CO2	Analyze the vibration effect of two degree of freedom mechanical systems.
CO3	Analyze the vibration effect of multi-degrees of freedom system by using various methods.
CO4	Analyze the effect of vibration in continuous system.
CO5	Identify the natural frequency of mechanical system by using vibration instruments.

Reference Books	
1.	W. T. Thomson, Marie Dillon Dahleh – “Theory of Vibration with Applications”, Pearson; 5th edition,1 November 2013.
2.	Den Hartog, J.P, “Mechanical Vibrations,” Dover Publications, 2013.

Approved by BoS Chairman

M.E.	M23EDP201 - VIBRATION LABORATORY	L	T	P	C
		0	0	4	2

Course Objectives	
1.	Introduce basic aspects of vibrational analysis, considering both single and multi-degree-of freedom systems.
2.	Discuss the use of exact and approximate methods in the analysis of complex systems.
3.	To develop and exercise critical thinking in interpreting results from FEM analysis such as the ability to identify the mode shapes, stress contours, eigen frequency as well as response characteristics.
4.	To be able to mathematically model real-world mechanical vibration problems.
5.	To use computer software programs to investigate and understand vibration problems.

List of Experiments	
Expt. No.	**Description of the Experiments**
1.	To determine forced Vibration of a Cantilever Beam with a Lumped Mass at Free End
2.	To determine the critical (whirling) speed of the given rotor.
3.	To determine moment of inertia of unknown object by oscillation
4.	To determine the radius of gyration ‘k’ of a given compound pendulum
5.	To determine the natural frequency of undamped torsional vibration of a single rotor shaft system.
6.	To determine the natural frequency of undamped torsional vibration of two rotor shaft system.
7.	To determine the frequency of undamped free vibration of an equivalent spring mass system
8.	To determine the frequency of damped force vibration of a spring mass system.
9.	Balancing of rotating masses
10.	Balancing of reciprocating masses in various speed
	Total Instructional hours : 45

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Course Outcomes : Students will be able to	
CO1	Solve the equations of motion for vibratory systems.
CO2	To determine the natural frequency of vibration problems that contains single and multidegree of freedom systems.
CO3	Identify the natural frequency (or frequencies) of vibratory systems.
CO4	To calculate the damping coefficient of single and multi-degree of freedom systems.
CO5	Design a passive vibration absorber to ameliorate vibrations in a forced system.

LIST OF EQUIPMENT FOR A BATCH OF 18 STUDENTS

Sl. No.	NAME OF THE EQUIPMENT	Qty.
1.	Transverse Vibration	1
2.	Compound Pendulum	1
3.	Single Rotor System	1
4.	Two Rotor System	1
5.	Spring Mass System	1
6.	Rotating Masses	1
7.	Reciprocating Mass	1
8.	Whirling of Shaft	1

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M.E.	M23EDP202 - DESIGN PROJECT	L	T	P	C
		0	0	4	2

Course Objectives	
1.	Identify the key processes and requirements of project management.
2.	Plan for project risks, communication, and change control.
3.	To offer students a glimpse into real world problems and challenges that need design based solutions.
4.	To introduce students to the vast array of literature available of the various research challenges in the field of design.
5.	To enable students to use all concepts of design in creating a solution for a problem.

Description of the Experiments
Each student is required to select any new component or an integrated mechanical system that involves various sub components which are to be designed as per design standards and further required to be analyzed for optimum dimensions with respect to the strength and stiffness
Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Construct a survey of several available literatures in the preferred field of study.
CO2	Choose and discuss the several existing solutions for research challenge.
CO3	Develop an ability to work in teams and manage the conduct of the research study.
CO4	Formulate and propose a plan for creating a solution for the research plan identified.
CO5	Develop and present the findings of the study conducted in the preferred domain.

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Professional Elective - I

M.E - E.D	M23EDE101 – OPTIMIZATION TECHNIQUES IN DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on various categories of optimization problems
2.	To understand the concept of Linear and Non-linear programming problem
3.	To understand the modern optimization algorithm
4.	To gain knowledge in topology optimization
5.	To understand the evolutionary structural optimization

UNIT - I	CLASSICAL OPTIMIZATION TECHNIQUES	9

Engineering applications of optimization, statement of optimization problem, classification of optimization problem, single variable optimization, multi variable optimization with no constraint, equality constraint, in-equality constraint

UNIT - II	LINEAR PROGRAMMING AND NON-LINEAR PROGRAMMING	9

Simplex algorithm, two phases of the simplex method, applications - One-dimensional minimization - exhaustive search, golden section method, quasi-newton method, random search methods, Powell's method

UNIT - III	MODERN METHODS OF OPTIMIZATION	9

Genetic algorithms, simulated annealing, fuzzy optimization, neural-network-based methods

UNIT - IV	TOPOLOGY OPTIMIZATION	9

Problem formulation and parameterization of design, solution methods, topology optimization as a design tool, combining topology and shape design, buckling problems, stress constraints

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UNIT - V	EVOLUTIONARY STRUCTURAL OPTIMIZATION (ESO) METHODS	9
ESO Based on Stress Level, evolutionary methods, two-bar frame, Michell type structure, ESO for stiffness or displacement optimization, Bi-directional Evolutionary Structural Optimization (BESO) method, BESO Based on von Mises Stress, topology optimization for natural frequency		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Identify the types of engineering optimization problem
CO2	Solve the linear and non linear optimization problems
CO3	Utilize the optimization algorithms GA, ANN, fuzzy etc for solving engineering problems.
CO4	Formulate and optimize the topology of the mechanical component
CO5	Utilize evolutionary structural optimization algorithms for optimizing engineering problems.

Reference Books	
1.	Goldberg, D.E., “Genetic Algorithms in Search, Optimization and Machine Learning”, Pearson, 2016.
2.	Johnson Ray, C., “Optimum design of mechanical elements”, Wiley, John & Sons, 2012.
3.	Kalyanmoy Deb, “Optimization for Engineering design algorithms and Examples”, Prentice Hall of India Pvt. 2014.
4.	Rao, Singaresu, S., “Engineering Optimization – Theory & Practice”, New Age International (P) Limited, New Delhi, 2010.

Approved by BoS Chairman

M.E - E.D	M23EDE102 - RESEARCH METHODOLOGY AND IPR	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand some basic concepts of research and its methodologies.
2.	To understand the methodology of carrying out research skills of analysing data using statistical tools.
3.	To highlight different mathematical tools for analysis.
4.	To get an idea about IPR.
5.	To know how to file a patent.

UNIT - I	HIST RESEARCH METHODOLOGY INTRODUCTION	9

Research methodology – definition and significance, types of research – exploratory research, conclusive research, modeling research, algorithmic research, casual research, theoretical and empirical research, cross-sectional and time series research. Research process - steps, research problems, objectives, characteristics, hypothesis and research in an evolutionary perspective

UNIT - II	SAMPLING TECHNIQUE / EXECUTING THE RESEARCH	9

Sampling methods – Probability sampling methods – simple random sampling with replacement and without replacement, stratified sampling, cluster sampling. Non-probability, sampling method – convenience sampling, judgment sampling, quota sampling. Nonparametric tests- One sample tests – one sample sign test, Kolmogorov-Smirnov test, run test for randomness, two sample tests – two sample sign test, Mann - Whitney U test, K-sample test – Kruskal Wallis test (H-test)

UNIT - III	MATHEMATICAL TOOLS FOR ANALYSIS	9

Hypothesis testing – Testing of hypotheses concerning means (one mean and difference between two means – one tailed and two tailed tests), concerning variance – one tailed Chi-square test. Introduction to Disciminant, Factor analysis, cluster analysis, multi-dimensional scaling, conjoint analysis, multiple regression and correlation, application of statistical software for data analysis

UNIT - IV	INTRODUCTION TO IPR	9

Introduction to IPRs, Basic concepts and need for Intellectual Property – Patents, Copyrights, Geographical Indications, IPR in India and Abroad – Genesis and Development – the way from WTO to WIPO – TRIPS, Nature of Intellectual Property, Industrial Property, technological Research, Inventions and Innovations – Important examples of IPR

Approved by BoS Chairman

UNIT - V	PATENT SPECIFICATION DRAFTING	9
Patentability of Inventions : Statutory Exceptions to Patentability; Novelty and Anticipation; Inventive Step; Capable of Industrial Application; Person Skilled in the Art, Provisional and Complete Specifications; Structure of a Patent Specification – Title, Abstract, Description, Claims, etc.; Reading a Patent Specification – Fair basis, Enabling Disclosure, Definiteness, Priority; Introduction to Patent Drafting		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Understand the basic framework of research process.
CO2	Examine the various research design and techniques.
CO3	Get knowledge on different mathematical tools for research data analysis.
CO4	Get knowledge on Intellectual Property Rights and their significance.
CO5	Recognize various Patent filling Procedures and Patent Specification.

Text Books	
1.	V. Scople Vinod, Managing Intellectual Property, Prentice Hall of India Pvt Ltd, 2012.
2.	Kothari, K.C., Research Methodology, 2nd Edition, New Age Publication, 2009.
3.	Dr.Tripathi, P.C, Research Methodology, 1st Edition, Prentice Hall Inc., 2009.

Reference Books	
1.	Donald R. Cooper and Pamela S. Schindler, business Research Methods, 9th Edition, Tata Mcgraw Hill, 2006.
2.	William G.Zikmund, Business Research Methods, 7th Edition, Tata Mc Graw Hill, 2009.

Approved by BoS Chairman

M.E - E.D	M23EDE103 - ENGINEERING FRACTURE MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on mechanics of cracked components of different modes by which these components fail under static load conditions.
2.	To impart knowledge on mechanics of cracked components of different modes by which these components fail under fatigue load conditions.
3.	To understand the relation between Energy balance and crack growth.
4.	To understand the effect of Fatigue crack growth.
5.	To understand the applications of fracture mechanics.

UNIT - I	ELEMENTS OF SOLID MECHANICS	9
The geometry of stress and strain, elastic deformation, plastic and elasto-plastic deformation – limit analysis – Airy's function – field equation for stress intensity factor		

UNIT - II	STATIONARY CRACK UNDER STATIC LOADING	9
Two dimensional elastic fields – Analytical solutions yielding near a crack front – Irwin's approximation - plastic zone size – Dugdaale model – determination of J integral and its relation to crack opening displacement		

UNIT - III	ENERGY BALANCE AND CRACK GROWTH	9
Griffith analysis – stable and unstable crack growth – Dynamic energy balance – crack arrest mechanism – K1c test methods - R curves - determination of collapse load		

UNIT - IV	FATIGUE CRACK GROWTH CURVE	9
Empirical relation describing crack growth law – life calculations for a given load amplitude – effects of changing the load spectrum – rain flow method – external factors affecting the K1c values - leak before break analysis		

Approved by BoS Chairman

UNIT - V	APPLICATIONS OF FRACTURE MECHANICS	9
Crack Initiation under large scale yielding – thickness as a design parameter – mixed mode fractures - crack instability in thermal and residual stress fields - numerical methods		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Develop the components that contain crack under static load condition.
CO2	Develop the components that contain crack and its growth under fatigue load condition.
CO3	Explain mechanics of crack tip fields and appropriate fracture characterizing parameters like stress intensity factor.
CO4	Construct for strength, stiffness or fatigue life make use of elementary concepts based on Strength of Materials and Theory of Elasticity.
CO5	Develop structural components taking into account presence of flaws, nature of loading and constitutive behavior of the material.

Reference Books	
1.	TribikramKundu, “Fundamentals of Fracture Mechanics”, Ane Books Pvt. Ltd. New Delhi / CRC Press, 1st Indian Reprint, 2012.
2.	Preshant Kumar, “Elements of Fracture Mechanics”, Wheeler Publishing, 2010.

Approved by BoS Chairman

M.E - E.D	M23EDE104 – ADDITIVE MANUFACTURING AND TOOLING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To educate students with fundamental knowledge in the field of Additive manufacturing technology and its applications
2.	Understand the various tools, processes and techniques for reverse engineering
3.	Understand the concepts and applications of liquid and solid based additive manufacturing techniques.
4.	Understand the concepts and applications of powder based additive manufacturing techniques.
5.	Understand the concept of tooling and its application automotive, aerospace and electronics industries.

UNIT - I	INTRODUCTION	9
Need - Development of AM systems – AM process chain - Impact of AM on Product Development - Virtual Prototyping- Rapid Tooling – RP to AM - Classification of AM processes-Benefits- Applications		

UNIT - II	REVERSE ENGINEERING AND CAD MODELING	9
Basic concept- Digitization techniques – Model reconstruction – Data Processing for Rapid Prototyping: CAD model preparation, Data requirements – Geometric modeling techniques: Wire frame, surface and solid modeling – data formats - Data interfacing, Part orientation and support generation, Support structure design, Model Slicing, Tool path generation-Software for AM- Case studies		

UNIT - III	LIQUID BASED AND SOLID BASED ADDITIVE MANUFACTURING SYSTEMS	9
Stereolithography Apparatus (SLA): Principle, pre-build process, part-building and post-build processes, photo polymerization of SL resins, part quality and process planning, Recoating issues, materials, advantages, limitations and applications. Solid Ground Curing (SGC): working principle, process, strengths, 9weaknesses and applications. Fused deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials and applications. Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations and applications - Case studies		

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UNIT - IV	POWDER BASED ADDITIVE MANUFACTURING SYSTEMS	9
Selective Laser Sintering (SLS) : Principle, process, Indirect and direct SLS - powder structures, materials, post processing, surface deviation and accuracy, Applications. Laser Engineered Net Shaping (LENS) : Processes, materials, products, advantages, limitations and applications – Case Studies		

UNIT - V	TOOLING	9
Classification, Soft tooling, Production tooling, Bridge tooling, direct and indirect tooling, Fabrication processes, Applications Case studies automotive, aerospace and electronics industries		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Infer history, concepts and terminology of additive manufacturing.
CO2	Apply the reverse engineering concepts for design development.
CO3	Construct the variety of additive manufacturing techniques.
CO4	Design and develop newer tooling models.
CO5	Analyze the cases relevant to mass customization and some of the important research challenges associated with AM and its data processing tools.

Reference Books	
1.	Chua, C.K., Leong K.F. and Lim C.S., “Rapid prototyping: Principles and applications”, second edition, World Scientific Publishers, 2010.
2.	Gebhardt, A., “Rapid prototyping”, Hanser Gardener Publications, 2003.
3.	Gibson, I., Rosen, D.W. and Stucker, B., “Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing”, Springer, 2010.
4.	Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC press, 2005.
5.	Kamrani, A.K. and Nasr, E.A., “Rapid Prototyping: Theory and practice”, Springer, 2006.

Approved by BoS Chairman

M.E - E.D	M23EDE105 – INFORMATION ANALYTICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Expose the students with fundamental concepts and the tools needed to understand emerging role of information analytics in the organization.
2.	Ability to solve problems associated with batch learning and online learning, and the big data characteristics such as high dimensionality, dynamically growing data and in particular scalability issues.
3.	Ability to understand and apply scaling up machine learning techniques and associated computing techniques and technologies.
4.	Ability to recognize and implement various ways of selecting suitable model parameters for different machine learning techniques.
5.	Ability to integrate machine learning libraries and mathematical and statistical tools with modern technologies like hadoop and mapreduce.

UNIT - I	DATA ANALYTICS LIFE CYCLE	9

Introduction to Big data Business Analytics - State of the practice in analytics role of data scientists - Key roles for successful analytic project - Main phases of life cycle - Developing core deliverables for stakeholders

UNIT - II	STATISTICS	9

Sampling Techniques - Data classification, Tabulation, Frequency and Graphic representation - Measures of central value - Arithmetic mean, Geometric mean, Harmonic mean, Mode, Median, Quartiles, Deciles, Percentile - Measures of variation – Range, IQR, Quartile deviation, Mean deviation, standard deviation, coefficient variance, skewness, Moments & Kurtosis

UNIT - III	PROBABILITY AND HYPOTHESIS TESTING	9

Random variable, distributions, two dimensional R.V, joint probability function, marginal density function. Random vectors - Some special probability distribution - Binomial, Poison, Geometric, uniform, exponential, normal, gamma and Erlang. Multivariate normal distribution - Sampling distribution – Estimation - point, confidence - Test of significance, 1 & 2 tailed test, uses of t distribution, F-distribution, X2 distribution

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UNIT - IV	PREDICTIVE ANALYTICS	9
Predictive modeling and Analysis - Regression Analysis, Multicollinearity, Correlation analysis, ank correlation coefficient, Multiple correlation, Least square, Curve fitting and good ness of fit		

UNIT - V	TIME SERIES FORECASTING AND DESIGN OF EXPERIMENTS	9
Forecasting Models for Time series: MA, SES, TS with trend, season - Design of Experiments, one way classification, two way classifications, ANOVA, Latin square, and Factorial Design		
	Total Instructional hours : 45	

Course Outcomes : Students will be able to	
CO1	Analyze the importance of data analysis in the design of new products.
CO2	Choose probability analysis and hypothesis testing.
CO3	Apply Perform predictive analysis.
CO4	Identify the effect of forecasting methods and to apply for business process.
CO5	Choose a reliable, scalable, distributed information system.

Reference Books

1.	Alberto Cordoba, “Understanding the Predictive Analytics Lifecycle”, Wiley, 2014.
2.	Chris Eaton, Dirk Deroos, Tom Deutsch et al., “Understanding Big Data”, McGraw Hill, 2012.
3.	James R Evans, “Business Analytics – Methods, Models and Decisions”, Pearson 2013.
4.	R. N. Prasad, Seema Acharya, “Fundamentals of Business Analytics”, Wiley, 2015.
5.	S M Ross, “Introduction to Probability and Statistics for Engineers and Scientists”, Academic Foundation, 2011.

Approved by BoS Chairman

Professional Elective - II

M.E - E.D	M23EDE201 - ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To gain knowledge on artificial intelligence.
2.	To understand the concepts of Machine Learning.
3.	To appreciate supervised learning and their applications.
4.	To appreciate the concepts and algorithms of unsupervised learning.
5.	To understand the theoretical and practical aspects of Probabilistic Graphical Models.

UNIT - I	ARTIFICIAL INTELLIGENCE	9

Artificial intelligence – Basics – Goals of artificial intelligence – AI techniques – problem representation in AI – Problem reduction and solution techniques - Application of AI and KBES in Robots

UNIT - II	INTRODUCTION TO MACHINE LEARNING	9

Machine Learning – Types of Machine Learning – Machine Learning process - preliminaries, testing Machine Learning algorithms, turning data into Probabilities, and Statistics for Machine Learning Probability theory – Probability Distributions – Decision Theory

UNIT - III	SUPERVISED LEARNING	9

Linear Models for Regression – Linear Models for Classification- Discriminant Functions, Probabilistic Generative Models, Probabilistic Discriminative Models – Decision Tree Learning – Bayesian Learning, Naïve Bayes – Ensemble Methods, Bagging, Boosting, Neural Networks, Multilayer Perceptron, Feed-forward Network, Error Back propagation - Support Vector Machines

UNIT - IV	UNSUPERVISED LEARNING	9

Clustering- K-means – EM Algorithm - Mixtures of Gaussians – Dimensionality Reduction, Linear Discriminant Analysis, Factor Analysis, Principal Components Analysis, Independent Components Analysis

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UNIT - V	PROBABILISTIC GRAPHICAL MODELS	9
Graphical Models – Undirected Graphical Models – Markov Random Fields – Directed Graphical Models – Bayesian Networks – Conditional Independence properties – Markov Random FieldsHidden Markov Models – Conditional Random Fields (CRFs)		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Develop the robots using Artificial Intelligence.
CO2	Select a learning model appropriate to the application.
CO3	Apply Probabilistic Discriminative and Generative algorithms for an application of your choice and analyze the results.
CO4	Identify applications suitable for different types of Machine Learning with suitable justification.
CO5	Utilize a tool to implement typical Clustering algorithms for different types of applications.

Reference Books	
1.	Christopher Bishop,“Pattern Recognition and Machine Learning” Springer, 2007.
2.	Stephen Marsland, “Machine Learning – An Algorithmic Perspective”, Chapman and Hall, CRC Press, Second Edition,2014.
3.	Kevin P. Murphy, “Machine Learning: A Probabilistic Perspective”, MIT Press, 2012.
4.	Ethem Alpaydin, “Introduction to Machine Learning”, MIT Press, Third Edition, 2014.
5.	Tom Mitchell, “Machine Learning”,McGraw-Hill,1997.

Approved by BoS Chairman

M.E - E.D	M23EDE202 - MODAL ANALYSIS OF MECHANICAL SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on modal testing and modal analysis of single and multi- degree of freedom systems.
2.	To understand the fundamentals of Vibration Theory.
3.	To understand the modeling and analysis of one-dof-systems - free vibrations, transient and steady-state forced vibrations, viscous and hysteric damping.
4.	To be able to mathematically model real-world mechanical vibration problems.
5.	To use computer software programs to investigate and understand vibration problems.

UNIT - I	INTRODUCTION	9
Introduction to Modal Testing – Applications of Modal Testing – Philosophy of Modal Testing – Summary of Theory – Summary of Measurement Methods – Summary of Analysis – Review of Test Procedure		

UNIT - II	VIBRATIONS	9
Introduction – Single Degree of Freedom (SDOF) System Theory – Presentation and Properties of FRF Data for SDOP System – Undamped Multi-degree of freedom (MDOF) system – Proportional Damping – Hysteretic Damping – General Case – Viscous Damping – General Case – Characteristics and presentation of MDOF – FRF Data – Complete and incomplete models - Nonsinusoidal vibration and FRF Properties – Analysis of Weakly Nonlinear Structures		

UNIT - III	MOBILITY MEASUREMENT TECHNIQUES	9
Introduction – Basic Measurement System – Structure preparation – Excitation of the Structure – Transducers and Amplifiers – Analyzers – Digital Signal Processing – Use of Different Excitation types – Calibration – Mass Cancellation – Rotational Mobility Measurement – Measurement on Non linear structures – Multi point excitation methods		

UNIT - IV	MODAL PARAMETER EXTRACTION METHODS	9
Introduction – Preliminary checks of FRF Data – SDOF Modal Analysis - I – Peak - amplitude – DOF Modal Analysis - II – Circle Fit Method – SDOF Modal Analysis III – Inverse Method – Residuals – MDOF curve-fitting procedures – MDOF curve fitting in the Time Domain – Global or Multi-Curve fitting – Non linear systems		

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UNIT - V	MATHEMATICAL MODELS	9
Introduction – Modal Models – Display of Modal Model – Response Models – Spatial Models – Mobility Skeletons and System Models		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Select the natural frequency of transverse vibrations of the shaft and torsional vibrations of rotor systems.
CO2	Identify the vibration measurement by using transducers and vibration exciters.
CO3	Select the natural frequencies and mode shapes of a multi degree of freedom system and explain the modal analysis of a vibrating system.
CO4	Select the numerical methods to determine natural frequencies of the beam and rotor systems.
CO5	Analyze the mathematical modeling of the two degrees of freedom systems and explain about the working principle of vibration absorber.

Text Books	
1.	Ewins Modal Testing: Theory and Practice “, John Wiley & Sons Inc., 1988 D J, “ 2013.

Reference Books	
1.	Michel Geradin, “Mechanical Vibrations : Theory and Application to Structural Dynamics”, 3rd Edition 2015.
2.	Singiresu S. Rao ., “ Vibration of Continuous Systems” 2nd Edition 2019.
3.	Nuno Manuel Mendes Maia et al, “Theoretical and Experimental Modal Analysis”, Wiley John & sons, 2012.

Approved by BoS Chairman

M.E - E.D	M23EDE203 - ADVANCED METAL FORMING TECHNIQUES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Analyze the concept of yield criteria applicable to different material deformation processes
2.	Analyse the mechanism of deformation in various forming process such as forging, rolling, extrusion and drawing.
3.	Select appropriate sheet metal forming technique
4.	Analyse the concept of advanced metal forming techniques.
5.	Apply the electromagnetic forming technique in industrial application

UNIT - I	INTRODUCTION TO THEORY OF PLASTICITY AND FORMING	9

Theory of plastic deformation – Yield criteria – Tresca and Von-mises – Distortion energy – Stress strain relation – Mohr's circle representation of a state of stress – cylindrical and spherical coordinate system – upper and lower bound solution methods – thermo elastic Elasto plasticity – elastovisco plasticity

UNIT - II	THEORY AND PRACTICE OF BULK FORMING PROCESSES	9

Analysis of plastic deformation in Forging, Rolling, Extrusion, rod/wire drawing and tube drawing – Effect of friction – calculation of forces, work done – Process parameters, equipment used – Defects – applications – Recent advances in Forging, Rolling, Extrusion and Drawing processes – Design consideration in forming - Formability of laminated sheet - Overview of FEM applications in Metal Forming analysis

UNIT - III	SHEET METAL FORMING	9

Formability studies – Conventional processes – H E R F techniques – Superplastic forming techniques – Hydro forming – Stretch forming – Water hammer forming – Principles and process parameters – Advantage, Limitations and application

UNIT - IV	POWDER METALLURGY AND SPECIAL FORMING PROCESSES	9

Overview of P/M technique – Advantages – applications – Powder preform forging – powder rolling - Tooling, process parameters and applications. - Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming

Approved by BoS Chairman

UNIT - V	ELECTROMAGNETIC FORMING AND ITS APPLICATIONS	9
Electromagnetic Forming Process – Electro – Magnetic Forming Machines – Process Variables – Coils and Dies – Effect of Resistivity and Geometry – EM tube and sheet forming, stamping, shearing and welding – Applications – Finite Element Analysis of EM forming		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply the mechanism of deformation for different metal forming processes and develop analytical relation between input and output parameters of process.
CO2	Analyze the concept of yield criteria applicable to different material deformation processes.
CO3	Apply theoretical and experimental techniques for measurement of important outcomes of metal forming processes.
CO4	Select the different lubrication mechanisms, lubricants and other valuable affecting the metal forming processes under different working conditions.
CO5	Select the different types of defects, causes and apply their remedial measures in metal forming process.

Text Books	
1.	Juneja.B.L. Fundamentals of metal cutting and machine tools, New age international, 2018.
2.	Richaerdheine (Author), Carlloper (Author), Philip Rosenthal (Author), Principles of metal casting, Mcgrawhill, 2017.

Reference Books	
1.	Ronakkhandelwal “Performance analysis of electromagnetic forming process”, 2015.
2.	H.S Shan, “Manufacturing Processes: Casting, Forming and Welding”, 2017.

Approved by BoS Chairman

M.E - E.D	M23EDE204 - SURFACE ENGINEERING	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study the surface preparation techniques.
2.	To import knowledge on thermal spraying process and electrodeposited coating.
3.	To study the process of Hot dip and diffusion coating.
4.	To induce the testing procedure for surface coating.
5.	Acquire knowledge in the selection of coatings.

UNIT - I	METAL CLEANING AND PREVIEW ON SURFACE ENGINEERING	8

Need and relevance of surface engineering – pre-treatment of coating, General cleaning process for ferrous and non-ferrous metals and alloys – selection of cleaning process – alkaline cleaning – emulsion cleaning- ultrasonic cleaning – acid and pickling salt bath descaling – abrasive bath cleaning– polishing and short peening – classification of surface engineering processes

UNIT - II	THERMAL SPRAYING PROCESSES AND ELECTRODEPOSITED COATINGS	10

Thermal spraying – flame, arc, plasma and HVOF processes – PLV process – design for thermally sprayed coatings – coating production – spray consumables principles of electroplating – Technology and control electroplating systems – properties and Faraday's Law – factors affecting throwing power – Applications of electrodeposites – non-aqueous and electroless deposition

UNIT - III	HOT DIP COATING AND DIFFUSION COATINGS	10

Principles – surface preparation batch coating and continuous coating process – coating properties and applications, Principles of cementation – cladding – Diffusion coating of C.N. Al, Si, Cr and B – structure, properties and application of diffusion coatings – chemical vapour deposition – physical vapour deposition

UNIT - IV	NON-METALLIC COATING OXIDE AND COVENSION COATINGS	9

Plating coating – laequers – rubbers and elastomers – vitreous enamels – anodizing phosphating and chromating – application to aluminium, magnesium, tin, zinc, cadmium copper and silver – phosphating primers

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UNIT - V	QUALITY ASSURANCE, TESTING AND SELECTION OF COATINGS	8
The quality plan – design – testing and inspection of thickness adhesion, corrosion, resistance and porosity measurement – selection of coatings – industrial applications of engineering coatings. Basic mechanisms of wear – abrasive, adhesive wear, contact fatigue – fretting corrosion – testing wear resistance practical diagnosis of wear		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the important of surface engineering to industries.
CO2	Demonstrate of the thermal spray for coating.
CO3	Explain the process and mechanism of different diffusion coating Process.
CO4	Explain the methods of non-metallic coating.
CO5	Explain the testing procedure for quality assurance.

Text Books	
1.	Stand Grainger engineering coatings – design and application jaico publishing House, 2010.

Reference Books	
1.	Parthasarathy. N.V., Electroplating Handbooks, Prentice Hall, 2011.
2.	Metals Hand Book, Vol. 2, 8th Edition, American society of metals 2012.
3.	Gabe. D.R., “Principles of Metal surface treatment and protection”, Pergamon, 2013.
4.	Niku-Lavi, “Advances in surface treatments”, Pergamon, 2014.

Approved by BoS Chairman

M.E - E.D	M23EDE205 – MECHANISMS DESIGN AND SIMULATION	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To develop a thorough understanding of the various mechanisms and its design and simulation with ability to effectively uses the various mechanisms in real life problems.
2.	Discuss the kinematic analysis of linkages in an assembly.
3.	Select the motion resulting from a specified set of linkages in a mechanism.
4.	Solve the displacement, velocity and acceleration at any point in a link of a mechanism.
5.	Analysis for special mechanisms and robotic manipulations.

UNIT - I	INTRODUCTION	5
Review of fundamentals of kinematics – mobility analysis – formation of one D.O.F. multi loop kinematics chains, Network formula – Gross motion concepts		

UNIT - II	KINEMATIC ANALYSIS	5
Position Analysis – Vector loop equations for four bar, slider crank, inverted slider crank, geared five bar and six bar linkages. Analytical methods for velocity and acceleration Analysis– four bar linkage jerk analysis. Planar complex mechanisms		

UNIT - III	PATH CURVATURE THEORY	6
Fixed and moving centrodes, inflection points and inflection circle. Euler Savary equation, graphical constructions – cubic of stationary curvature		

UNIT - IV	SYNTHESIS OF MECHANISMS	15
Type synthesis – Number synthesis – Associated Linkage Concept. Dimensional synthesis – function generation, path generation, motion generation. Graphical methods. Cognate linkages -Coupler curve synthesis, design of six-bar mechanisms. Algebraic methods. Application of instant centre in linkage design. Cam Mechanisms – determination of optimum size of Cams		

Approved by BoS Chairman

UNIT - V	DYNAMICS OF MECHANISMS , SPATIAL MECHANISMS AND ROBOTICS	14
Static force analysis with friction – Inertia force analysis – combined static and inertia force analysis, shaking force, Kinetostatic analysis. Introduction to force and moment balancing of linkages.Kinematic Analysis of Spatial RSSR mechanism – Denavit – HartenbergParameters.Forward and inverse Kinematics of Robotic Manipulators. Study and use of Mechanism using Simulation Software packages		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain and discuss the kinematic analysis of linkages in an assembly.
CO2	Solve the displacement, velocity and acceleration at any point in a link of a mechanism.
CO3	Select the motion resulting from a specified set of linkages in a mechanism.
CO4	Organize the mechanism of cams and to find their optimum sizes.
CO5	Choose analysis for special mechanisms and robotic manipulations.

Text Books	
1.	Arthur G. Erdman,George N. SandoR,"Mechanism Design: Analysis and Synthesis", Prentice Hall Mar 2017.
2.	Shigley, J.E., and Uicker, J.J., “Theory of Machines and Mechanisms”, McGraw Hill, 2013.

Reference Books	
1.	AmitabhaGhosh and Asok Kumar Mallik, “Theory of Mechanism and Machines”, EWLP, Delhi, 2009.
2.	Norton R.L., “Design of Machinery”, McGraw Hill, 2003.
3.	Kenneth J, Waldron, Gary L. Kinzel, “Kinematics, Dynamics and Design of Machinery”, John Wiley-sons, 2007.
4.	Uicker.J.J, Pennock.G.R, Shighley.J.E, “Theory of machines and mechanisms”, Oxford university press, 2005.

Approved by BoS Chairman

M.E - E.D	M23EDE206 – DESIGN OF MATERIAL HANDLING EQUIPMENTS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Fundamental concepts related to material handling
2.	Design of various hoisting component for different material handling applications
3.	Select suitable drive system for hoisting
4.	Development of conveyer systems for material flow in different industrial production systems
5.	Design of elevators for various manufacturing and service applications.

UNIT - I	MATERIALS HANDLING EQUIPMENT	5

Overview - consideration in material handling system design, ten principles of material handling. Types of material handling equipments, selection and applications

UNIT - II	DESIGN OF HOISTS	10

Design of hoisting elements: Welded and roller chains - Hemp and wire ropes - Design of ropes, pulleys, pulley systems, sprockets and drums, Load handling attachments. Design of forged hooks and eye hooks – crane grabs - lifting magnets - Grabbing attachments - Design of arresting gear - Brakes: shoe, band and cone types

UNIT - III	DRIVES OF HOISTING GEAR	10

Hand and power drives - Traveling gear - Rail traveling mechanism - cantilever and monorail cranes - slewing, jib and bluffing gear - cogwheel drive - selecting the motor ratings

UNIT - IV	CONVEYORS	10

Types - description - design and applications of Belt conveyors, apron conveyors and escalators Pneumatic conveyors, Screw conveyors and vibratory conveyors

UNIT - V	ELEVATORS	10

Bucket elevators: design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks

Approved by BoS Chairman

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline the importance of proper material handling techniques and regarding hoisting and conveying equipment.
CO2	List the hazards associated with hoisting and conveying.
CO3	Illustrate the various hoisting gear drives used in various applications.
CO4	Apply knowledge and attention on various types of conveyor designs.
CO5	List the different types of elevators and trucks and their design.

Reference Books	
1.	Alexandrov, M., Materials Handling Equipments, MIR Publishers, 1981.
2.	Boltzharol, A., Materials Handling Handbook, the Ronald Press Company, 1958.
3.	Conveyor Equipment Manufacturer's Association, "Belt conveyors for bulk materials" 6th edition, The New CEMA Book, 2018.
4.	P.S.G. Tech., "Design Data Book", KalaikathirAchchagam, Coimbatore, 2003.
5.	Rudenko, N., Materials handling equipment, ELnvee Publishers, 1970.
6.	Spivakovsy, A.O. and Dyachkov, V.K., Conveying Machines, Volumes I and II, MIR Publishers, 2011.

Approved by BoS Chairman

M.E - E.D	M23EDE207 - BIOMATERIALS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To study different concepts in selecting bio and smart materials.
2.	To import knowledge on different electro-rheological and piezoelectric materials.
3.	To import knowledge on different shape memory materials and their applications of materials in biomedical engineering and special materials for actuators, sensors, etc.
4.	To import knowledge on Materials for oral and maxillofacial surgery.
5.	To import knowledge on materials for cardiovascular ophthalmology and skin regeneration.

UNIT - I	INTRODUCTION	9

Human anatomy- tissues- organs- repair- regeneration- Wolff's Law – biomaterial – compatibility – classification - Biomimetics – Material response: swelling and leaching, corrosion and dissolution, deformation and failure, friction and wear – host response: the inflammatory process – coagulation and hemolysis- in vitro and in vivo evaluation of biomaterials – Testing and validation - government regulatory bodies

UNIT - II	DENTAL MATERIALS	9

Teeth composition, formation and properties – temporary fixation devices -classification – biomaterials used- metals and alloys - Fillings and restoration materials – oral and maxillofacial surgery – dental cements and dental amalgams – dental adhesives

UNIT - III	ORTHOPAEDIC MATERIALS	9

Bone composition, formation and regeneration - properties – defects - temporary fixation devices – joint replacement – biomaterials used in bone and joint replacement metals and alloys- stress shielding effect- bone tissue engineering

UNIT - IV	WOUND DRESSING MATERIALS AND SURGICAL AIDS	9

Skin structure – defects (burn, ulcer, trauma etc) and disease- skin regeneration – classification of regenerative material – Sutures- Adhesives – classification – Surgical toolsmaterials – sterilization - Laparoscopic tools

Approved by BoS Chairman

UNIT - V	CARDIOVASCULAR, OPTHALMOLOGY AND DRUG DELIVERY MATERIALS	9
Blood clotting – blood theology – approaches to thrombo resistance materials development – blood vessels – The heart – aorta and valves – geometry of blood circulation – cardiac pacemakers – extracorporeal blood circulation devices. lungs – vascular implants: vascular graft, cardiac valve prostheses – Eye - defects – correction - Biomaterials in opthalmology – drug delivery methods and materials		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Use of Bio materials for cardiovascular Opthalmology and Skin Regeneration.
CO2	Use of Bio materials for Dental & Bone application.
CO3	Use of shape memory alloys in engineering application.
CO4	Explain the characteristics of Bio and smart materials.
CO5	Use of smart materials as sensors, actuators.

Reference Books	
1.	Mohsen Shahinpoor and Hans-Jorg Schneider “Intelligent Materials”, RSC Publishing, 2008.
2.	Sujata V., Bhat., “Biomaterials”, Narosa Publication House, New Delhi, 2002.
3.	Buddy D. Ratner (Editor), Allan S. Hoffman (Editor), Frederick J. Schoen (Editor), Jack E. Lemons, “Biomaterials Science: An Introduction to Materials in Medicine”, Academic Press, 2nd edition, 2004.
4.	M. V. Gandhi and B. S. Thompson, “Smart Materials and Structures”, Chapman and Hall, London, First Edition, 1992.
5.	Duerig, T.W., Melton, K.N, Stockel, D. and Wayman, C.M., “Engineering aspects of Shape memory Alloys”, Butterworth – Heinemann, 1990.

Approved by BoS Chairman

M.E - E.D	M23EDE208 - MECHANICAL MEASUREMENTS AND ANALYSIS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	The student will understand the principle of force and strain measurement.
2.	The student will understand the vibration measurement and their applications.
3.	To impart knowledge on the principle behind acoustics and wind flow measurements.
4.	To familiarize with the distress measurements.
5.	To realize the non-destructive testing principle and application.

UNIT - I	FORCES AND STRAIN MEASUREMENT	9

Strain gauge, principle, types, performance and uses. Photo elasticity – Principle and applications - Moire Fringe - Hydraulic jacks and pressure gauges – Electronic load cells – Proving Rings – Calibration of Testing Machines

UNIT - II	VIBRATION MEASUREMENTS	9

Characteristics of Structural Vibrations – Linear Variable Differential Transformer(LVDT) – Transducers for velocity and acceleration measurements. Vibration meter – Seismographs – Vibration Analyzer – Display and recording of signals – Cathode Ray Oscilloscope – XY Plotter – Chart Plotters – Digital data Acquisition systems

UNIT - III	ACOUSTICS AND WIND FLOW MEASUREMENTS	9

Principles of Pressure and flow measurements – pressure transducers – sound level meter – venturimeter and flow meters – wind tunnel and its use in structural analysis – structural modeling – direct and indirect model analysis

UNIT - IV	DISTRESS MEASUREMENTS	9

Diagnosis of distress in structures – crack observation and measurements – corrosion of reinforcement in concrete – Half-cell, construction and use – damage assessment – controlled blasting for demolition

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UNIT - V	NON DESTRUCTIVE TESTING METHODS	9
Load testing on structures, buildings ,bridges and towers – Rebound Hammer – acoustice mission – ultrasonic testing principles and application – Holography – use of laser for structural testing – Brittle coating		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Measure physical quantities such as forces and strains.
CO2	Apply different vibration measurements techniques.
CO3	Measure physical quantities such as pressure and flow.
CO4	Apply techniques involved in crack measurement.
CO5	Select the appropriate nondestructive testing methods for various engineering applications.

Reference Books	
1.	Sadhu Singh, Experimental Stress Analysis, Khanna Publishers, New Delhi, 2009.
2.	James W. Dally and William Franklin Riley, "Experimental Stress Analysis", McGraw Hill, 3rd Edition,1991.
3.	Bray Don E and Stanley, R.K., "Non-destructive Evaluation", McGraw Hill Publishing Company, N.Y. 1989.
4.	Garas, F.K., Clarke, J. Land Armer GST, "Structuralassessment", Butter worths, London,1987.
5.	Sirohi, R.S. and Radhakrishna, H.C, "MechanicalMeasurements", New Age International (P) Ltd, 3rd Edition, 1997.

Approved by BoS Chairman

M.E - E.D	M23EDE209 - COMPUTATIONAL FLUID DYNAMICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	This course aims to introduce numerical modeling and its role in the field of heat, fluid flow and combustion. It will enable the students to understand the various discretization methods and solving methodologies and to create confidence to solve complex problems in the field of heat transfer and fluid dynamics.
2.	To develop finite volume discretised forms of the governing equations for diffusion processes.
3.	To develop finite volume discretised forms of the convection-diffusion processes.
4.	To develop pressure-based algorithms for flow processes.
5.	To introduce various turbulence models, Large Eddy Simulation and Direct Numerical Simulation.

UNIT - I	GOVERNING DIFFERENTIAL EQUATIONS AND DISCRETISATION TECHNIQUES	9

Basics of Heat Transfer, Fluid flow – Mathematical description of fluid flow and heat transfer – Conservation of mass, momentum, energy and chemical species - Classification of partial differential equations – Initial and Boundary Conditions – Discretisation techniques using finite difference methods – Taylor's Series - Uniform and non-uniform Grids, Numerical Errors, Grid Independence Test

UNIT - II	DIFFUSION PROCESSES : FINITE VOLUME METHOD	9

Steady one-dimensional diffusion, Two- and three-dimensional steady state diffusion problems, Discretisation of unsteady diffusion problems – Explicit, Implicit and Crank-Nicholson's schemes, Stability of schemes

UNIT - III	CONVECTION-DIFFUSION PROCESSES: FINITE VOLUME METHOD	9

One dimensional convection – diffusion problem, Central difference scheme, upwind scheme – Hybrid and power law discretization techniques – QUICK scheme

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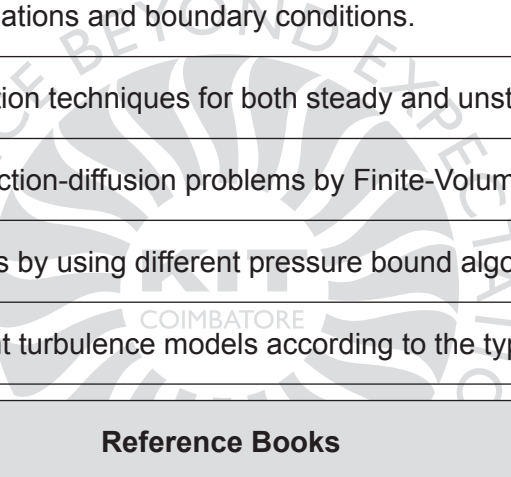
UNIT - IV	FLOW PROCESSES : FINITE VOLUME METHOD	9
Discretisation of incompressible flow equations – Pressure based algorithms, SIMPLE, SIMPLER & PISO algorithms		

UNIT - V	TURBULENCE MODELS	9
Turbulence – RANS equation - Algebraic Models, One equation model, Two equation models – k & standard k – ϵ model, Low Reynold number models of k- ϵ, Large Eddy Simulation (LES), Direct Numerical Simulation (DNS) - Introduction. Solving simple cases using standard CFD codes		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Analyse the governing equations and boundary conditions.
CO2	Analyse various discretization techniques for both steady and unsteady diffusion problems.
CO3	Analyse the various convection-diffusion problems by Finite-Volume method.
CO4	Analyse the flow processes by using different pressure bound algorithms.
CO5	Select and use the different turbulence models according to the type of flows.

Reference Books

1. Versteeg and Malalasekera, N, “An Introduction to computational Fluid Dynamics The Finite Volume Method,” Pearson Education, Ltd., Second Edition, 2014.
2. JiyuanTu, Guan Heng Yeoh, Chaogun Liu, “Computational Fluid Dynamics A Practical Approach” Butterworth – Heinemann An Imprint of Elsevier, Madison, U.S.A., 2008.
3. Muralidhar, K., and Sundararajan, T., “Computational Fluid Flow and Heat Transfer”, Narosa Publishing House, New Delhi, 2003.



Approved by BoS Chairman

M.E - E.D	M23EDE210 - DESIGN OF HYBRID AND ELECTRIC VEHICLES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Fundamental concepts of electric and hybrid vehicle operation and architectures.
2.	Understand the properties of batteries and its types.
3.	Provide knowledge about design of series hybrid electric vehicles.
4.	Provide knowledge about design of parallel hybrid electric vehicles.
5.	Understand of electric vehicle drive train.

UNIT - I	INTRODUCTION TO ELECTRIC VEHICLES	9

Electric Vehicles (EV) system - EV History – EV advantages – EV market – vehicle mechanics : roadway fundamentals - law of motion - vehicle kinetics - dynamics of vehicle motion – propulsion power – velocity and acceleration - propulsion system design

UNIT - II	ENERGYSOURCE	9

Battery basics - lead acid battery – alternative batteries – battery parameters - technical characteristics – battery power – alternative energy sources : Fuel cells - Fuel Cell characteristics - Fuel cell types

UNIT - III	SERIES HYBRID ELECTRIC DRIVE TRAIN DESIGN	9

Operation Patterns - Control Strategies - Sizing of the Major Components - Design of peaking power source - Traction Motor Size - Design of the Gear Ratio - Verification of Acceleration Performance - Verification of grade ability - Design of Engine/Generator Size - Design of the Power Capacity Design of the Energy Capacity – Fuel Consumption

UNIT - IV	PARALLEL HYBRID ELECTRIC DRIVE TRAIN DESIGN	9

Control Strategies of Parallel Hybrid Drive Train - Drive Train Parameters - Engine Power Capacity Electric Motor Drive Power Capacity - Transmission Design - Energy Storage Design

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UNIT - V	ELECTRIC VEHICLE DRIVE TRAIN	9
EV Transmission configurations – Transmission components – Ideal gear box – Gear ratiotorque – speed characteristics - EV motor sizing – initial acceleration - rated vehicle velocity – maximum velocity – maximum gradability		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain how a hybrid vehicle works and describe its main components and their function.
CO2	Choose proper energy storage systems for vehicle applications.
CO3	Design series hybrid electric vehicles.
CO4	Design parallel hybrid electric vehicles.
CO5	Describe the transmission components and their configurations for electric vehicles.

Reference Books	
1.	Iqbal Hussain, “Electric & Hybrid Vehicles – Design Fundamentals”, Second Edition, CRC Press, 2011.
2.	Ehsani, M, “Modern Electric, Hybrid Electric and Fuel Cell Vehicles: Fundamentals, Theory and Design”, CRC Press, 2005.
3.	James Larminie, “Electric Vehicle Technology Explained”, John Wiley & Sons, 2003.

Approved by BoS Chairman

Semester - III

M.E - E.D	M23EDP301 - PROJECT WORK PHASE - I	L	T	P	C
		0	0	12	6

Course Objectives	
1.	To identify a specific problem for the current need of the society and collecting information related to the same through detailed review of literature.
2.	To develop the methodology to solve the identified problem.
3.	To train the students in preparing project reports and to face reviews a viva-voce examination.

Description of the Experiments

The student individually works on a specific topic approved by the head of the division under the guidance of a faculty member who is familiar in this area of interest. The student can select any topic which is relevant to the area of engineering design. The topic may be theoretical or case studies. At the end of the semester, a detailed report on the work done should be submitted which contains clear definition of the identified problem, detailed literature review related to the area of work and methodology for carrying out the work. The students will be evaluated through a viva-voce examination by a panel of examiners including one external examiner

Total Instructional hours : 180

Course Outcome

Design project at the end of the course the students will have a clear idea of their area of work and they will be in a position to carry out the remaining phase II work in a systematic way

Approved by BoS Chairman

M.E - E.D	M23EDE301 - ADVANCED STRENGTH OF MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand and explain the concept of stress – strain relationship.
2.	To understand the general equation of elasticity.
3.	To analyze the problems in curved and flat plates.
4.	To understand the problems in torsions in tubes and non circular sections.
5.	To analyze the problems in contact stresses.

UNIT - I	ELASTICITY	9

Stress - Strain relations and general equations of elasticity in Cartesian, Polar and spherical coordinates differential equations of equilibrium-compatibility-boundary conditions representation of three - dimensional stress of a tension generalized hook's law - St. venant's principle-plane stress Airy's stress function

UNIT - II	SHEAR CENTER AND UNSYMMETRICAL BENDING	10

Location of shear center for various sections - shear flows, Stresses and deflections in beams subjected to unsymmetrical loading - kern of a section

UNIT - III	CURVED FLEXIBLE MEMBERS AND STRESSES IN FLAT PLATES	10

Circumference and radial stresses - deflections - curved beam with restrained ends - closed ring subjected to concentrated load and uniform load-chain links and crane hooks - Stresses in circular and rectangular plates due to various types of loading and end conditions - buckling of plates

UNIT - IV	TORSION OF NON-CIRCULAR SECTIONS	7

Torsion of rectangular cross section - St. Venants theory - elastic membrane analogy prandtl's stress function - torsional stress in hollow thin walled tubes

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UNIT - V	STRESSES DUE TO ROTARY SECTIONS AND CONTACT STRESSES	9
Radial and tangential stresses in solid disc and ring of uniform thickness and varying thickness allowable speeds. Methods of computing contact stress-deflection of bodies in point and line contact applications		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply the concepts of theory of elasticity in three-dimensional stress system.
CO2	Determine the shear centre of various cross-sections and deflections in beams subjected to unsymmetrical bending.
CO3	Evaluate the stresses in flat plates and curved members.
CO4	Calculate torsional stress of non-circular sections.
CO5	Determine the stresses in rotating members, contact stresses in point and line contact applications.

Reference Books	
1.	Timoshenko and Goodier, “Theory of Elasticity”, McGraw Hill Education (India) Private Limited, 3rd Edition, February, 2010.
2.	Arthur P. Boresi, Richard J. Schmidt, Advanced Mechanics of Materials, 6th Edition, Wiley, New York, 2002.
3.	Allan F. Bower, “Applied Mechanics of Solids”, CRC press – Special Indian Edition, 2012
4.	Hibbeler. R.C., “Mechanics of Materials”, Prentice Hall, 2018.
5.	Srinath. L.S., “Advanced Mechanics of Solids”, Tata McGraw Hill, 2009

Approved by BoS Chairman

M.E - E.D	M23EDE302 - DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To develop efficient hydraulic and pneumatic circuits.
2.	To impart students on the science, use and application of hydraulics and pneumatics as fluid power in Industry.
3.	To impart knowledge on the methodology of basic and advanced design of pneumatics and hydraulics systems.
4.	Identify various components of Pneumatic and Hydraulic control systems.
5.	Design and analyse problems relating to Pneumatic and Hydraulic control systems and components.

UNIT - I	OIL HYDRAULIC SYSTEMS AND HYDRAULIC ACTUATORS	9

Hydraulic Power Generators – Selection and specification of pumps, pump characteristics. Linear and Rotary Actuators – selection, specification and characteristics

UNIT - II	CONTROL AND REGULATION ELEMENTS	9

Pressure - direction and flow control valves - relief valves, non-return and safety valves – actuation systems

UNIT - III	HYDRAULIC CIRCUITS	9

Reciprocation, quick return, sequencing, synchronizing circuits - accumulator circuits – industrial circuits - press circuits - hydraulic milling machine - grinding, planning, copying, - forklift, earth mover circuitsdesign and selection of components - safety and emergency mandrels

UNIT - IV	PNEUMATIC SYSTEMS AND CIRCUITS	9

Pneumatic fundamentals - control elements, position and pressure sensing - logic circuits – switching circuits - fringe conditions modules and these integration - sequential circuits - cascade methods - mapping methods - step counter method - compound circuit design - combination circuit design

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UNIT - V	ELECTRONIC CONTROL OF HYDRAULICS & PNEUMATIC CIRCUIT	9
Electrical control of pneumatic circuits – use of relays, counters, timers, ladder diagrams, use of microprocessor in circuit design – use of PLC in hydraulic and pneumatic circuits -fault finding - hydro pneumatic circuits - use of microprocessors for sequencing - PLC, Low cost automation-Robotic circuits		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Demonstrate the working of different types of pumps and actuators
CO2	Explain the working and actuation mechanism of control valves.
CO3	Design hydraulic circuits for various applications.
CO4	Explain the fundamentals of pneumatics and construct pneumatic circuits.
CO5	Construct ladder diagram for controlling hydraulic and pneumatic circuits

Reference Books	
1.	Anthony Esposito, “Fluid Power with Applications”, Pearson Education; 7th edition 2013.
2.	James R. Daines “Fluid Power: Hydraulics and Pneumatics” August 2012.
3.	Andrew Parr, “Hydraulics and Pneumatics: A Technician's and Engineer's Guide”, Elsevier, 3rd Revised edition, January 2011.
4.	Jagadeesha T, “Pneumatics Concepts, Design and Applications “, Universities Press, 2015
5.	Majumdar S.R., “Oil Hydraulic Systems – Principles and Maintenance”, 2nd Edition, Tata McGraw-Hill, New Delhi, 2012.

Approved by BoS Chairman

M.E - E.D	M23EDE303 - DESIGN FOR X	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the design Principles for Manufacturability and GD&T.
2.	To apply design principles focusing on easy machining of component.
3.	To understand the design principles for maintainability and reliability.
4.	To apply design principles for improving the sustainability of product.
5.	To gain knowledge about the design for additive manufacturing.

UNIT - I	INTRODUCTION	9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances - Assembly limits - Datum features - Tolerance stacks - FACTORS INFLUENCING FORM DESIGN - Working principle, Material, Manufacture, Design - Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings

UNIT - II	COMPONENT DESIGN - MACHINING CONSIDERATION	9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation - simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility

UNIT - III	DESIGN FOR RELIABILITY AND MAINTAINABILITY	9

Reliability design process, system effectiveness, economic analysis and life cycle cost, reliability allocation, design methods, parts and material selection, derating, stress - strength and analysis, failure analysis, identification determination of causes, assessments of effects, computation of criticality index, corrective action, system safety – analysis of down-time – the repair time distribution, stochastic point processes system repair time, reliability under preventive maintenance state dependent system with repair. MTTR – mean system down time, repair vs replacement, replacement models, proactive, preventive, predictive maintenance maintainability and availability, optimization techniques for system reliability with redundancy heuristic methods applied to optimal system reliability

Approved by BoS Chairman

UNIT - IV	SUSTAINABLE DESIGN	9
Industrial ecology, multiple life cycle design, principles of design, green engineering, cradle to cradle design, The Natural Step, biomimicry, design for reuse, dematerialization, modularization, Design to minimize material usage – Design for disassembly – Design for recyclability – design for flexibility, design for disassembly, design for inverse manufacturing, design for the environment, – Design for energy efficiency – Design to regulations and standards etc		

UNIT - V	DESIGN FOR ADDITIVE MANUFACTURING	9
Concepts and Objectives - AM Unique Capabilities - Part Consolidation - Topology Optimization - Lightweight Structures - DFAM for Part Quality Improvement - CAD Modeling - Model Reconstruction - Data Processing for AM		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Select relevant process; apply the general design principles for manufacturability; GD&T
CO2	Apply design considerations while designing the formed and machined components
CO3	Be exposed to maintenance systems and reliability based design
CO4	Apply design considerations for environmental issues
CO5	Apply design considerations for additive manufacturing

Text Books	
1.	Boothroyd, G , Dewhurst, P, and Knight, W, “Product Design for Manufacture and Assembly”, 3rd Edition, CRC Press, Taylor & Francis, 2010
2.	Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.

Approved by BoS Chairman

Reference Books	
1.	Karl Ulrich, Steven Eppinger, Maria C. Yang, “Product Design And Development”, McGraw Hill, 2020
2.	K.Venkataraman, “Maintenance Engineering and Management”, PHI Learning, 2007.
3.	Fixel, J. Design for the Environment McGraw Hill., 1996.
4.	Ben Redwood, Brian Garret, Filemon Schöffer, and Tony Fadel, “The 3D Printing Handbook : Technologies, Design and Applications”, 3D Hubs B.V., Netherland, 2017. ISBN-13: 978-9082748505.

Approved by BoS Chairman

M.E - E.D	M23EDE304 - PRODUCT DESIGN FOR SUSTAINABILITY	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the basic concepts of sustainability.
2.	To gain knowledge about the tools and techniques for sustainable design.
3.	To understand the principles for sustainable design.
4.	To improve the design by assessing the customer needs.
5.	To know the knowledge about various marketing techniques.

UNIT - I	BASIC CONCEPTS IN SUSTAINABILITY	9

Understanding the language of sustainable engineering design, construction and operation. Natural resources terminology. Carrying capacity. Sustainable development, corporate responsibility, biophysical constraints, environmental management

UNIT - II	TOOLS AND TECHNIQUES	9

Sustainable Engineering Design Tools – Life cycle analysis, carbon foot printing. Life cycle assessment (LCA), Types of LCA‟s: baseline, comparative, streamlined. LCA inventory analysis: process or inputoutput. Hybrid inventory analysis. Sustainable Product Design. Whole systems design. Light weighting and materials reduction. Designing for a lifetime. Design for durability, repair and upgrade disassembly and recycling. Energy use in design. Reducing energy losses in design

UNIT - III	FOUNDATIONAL CONCEPTS & PRINCIPLES FOR SUSTAINABLE BREAKTHROUGH DESIGN	9

Infrastructure for managing flows of materials, energy and activities; sustainable value creation approaches for all stakeholders, environmental design characteristics; design changes & continual improvement; inclusive sustainable design principles, crowd sourcing, multiple-objective designs; infrastructures that support system thinking; knowledge management for sustainable design, learning systems and experimentation; smart data systems, understanding variation

Approved by BoS Chairman

UNIT - IV	SUSTAINABLE DESIGN	9
Industrial ecology, multiple life cycle design, principles of design, green engineering, cradle to cradle design, The Natural Step, bio mimicry, design for reuse, dematerialization, modularization, design for flexibility, design for disassembly, design for inverse manufacturing, design for the environment, etc.		

UNIT - V	CUSTOMER AND USER NEEDS ASSESSMENT	9
Identification & breakdown structures that describe customers & stakeholders, green marketing, socially conscious consumerism, sources of customer information, collecting information, analyzing customer behavior, translating the voice of the customer, use analysis, structuring customer needs, service gap analysis, prioritizing customer needs, strategic design, Kano technique		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Apply the concept of sustainability in terms of design, construction and development.
CO2	Make use of life cycle assessment and other technique for a design.
CO3	Apply sustainable value creation approaches, design changes & continual improvement.
CO4	Choose sustainable design, green engineering, flexible design etc.
CO5	Design according to the customer needs and Design the products that are environmentally friend.

Reference Books	
1.	Clarke, Abigail & John K. Gershenson, “Design for the Life Cycle,” Life-cycle Engineering Laboratory, , 2006.
2.	Finster, Mark P., “Sustainable Perspectives to Design and Innovation”, 2013.
3.	Ramaswamy, Rohit, “Design and Management of Service Processes: Keeping Customers for Life”, Prentice Hall, 1996.
4.	Schmitt, Brent, “Customer Experience Management”, Wiley and Sons, 2003.

Approved by BoS Chairman

M.E - E.D	M23EDE305 - GREEN MANUFACTURING PRACTICES	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge of air pollution.
2.	To know impact of Nosie pollution.
3.	To understand water demand and water quality.
4.	To understand the concepts of environmentally friendly machining.
5.	To understand the strategies for reducing waste in manufacturing.

UNIT - I	AIR POLLUTION SAMPLING AND MEASUREMENT	9

Primary and Secondary Pollutants, Automobile Pollutants, Industrial Pollution, Ambient air quality Standards, Metrological aspects of air Pollution, Temperature lapse Rates and Stability-wind velocity and turbulence-Pump behavior dispersion of air Pollutants- solution to the atmosphere dispersion equationthe Gaussian Plume Model, Air pollution sampling-collection of gaseous air pollutants-collection of particulate pollutants-stock sampling, analysis of air pollutants-sulfur dioxide-nitrogen dixide, carbon monoxide, oxidants and ozone

UNIT - II	NOISE POLLUTION & CONTROL	9

Frequency and Sound Levels, Units of Noise based power radio, contours of Loudness. Effect of human, Environment and properties, Natural and Anthrogenic Noise Sources, Measuring Instruments for frequency and Noise levels, Masking of sound, Types, Kinetics, Selection of different reactors used for waste treatment, Treatment of noise at source, Path and Reception, Sources of noise, Effects of noise-Occupational Health hazards, thermal Comforts, Heat Island Effects, Radiation Effects

UNIT - III	WATER DEMAND, WATER QUALITY	9

Factors affecting consumption, Variation, Contaminants in water, Nitrates, Fluorides, Detergents, taste and odour, Radio activity in water, Criteria, for different impurities in water for portable and non portable use, Point and non-point Source of pollution, Major pollutants of Water, Water Quality Requirement for different uses, Global water crisis issues

Approved by BoS Chairman

UNIT - IV	ENVIRONMENTALLY - FRIENDLY MACHINING	9
Sustainable Manufacturing Technologies - Dry Machining and Near - Dry Machining - Cryogenic Machining - High Pressure Jet Assisted Machining - Assessment of Machining Process Sustainability - Assessment Methods - Material Production, Cutting Fluid Preparation, Tool Preparation, Machine Tool Construction, Material Removal, Cleaning Process		

UNIT - V	ZERO-WASTE IN MANUFACTURING	9
Concepts of Zero Waste in Manufacturing - Waste Assessment Process and Systems Approach - Common Strategies for Zero Waste - Recyclable Product Identification, Paper Product Reduction Strategies, Collection Stations, Packaging, Source Reduction, Green Purchases and Green Partners - Case Study		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Understand the impact of air pollution and tools for air pollution measurement.
CO2	Determine the noise pollution of environment.
CO3	Explain the Factors affecting consumption of water and quality of water.
CO4	Choose the machining process that are environmentally friendly.
CO5	Apply various strategies to achieve zero waste in manufacturing.

Reference Books	
1.	Dornfield David, Green Manufacturing, Springer, 2012.
2.	Davim.J.Paulo, Green Manufacturing Processes and Systems, Springer, 2013.
3.	Cairncrss, Francis, Costing the Earth: The Challenge for Governments, the Opportunities for Business, Harvard Business School Press, 2009.
4.	Gradel.T.E. and B.R. Allenby, Industrial Ecology, Prentice Hall, 2010.
5.	World Commission on Environment and Development (WCED), Our Common Future, Oxford University Press, 2005.

Approved by BoS Chairman

M.E - E.D	M23EDE306 - DESIGN FOR MANUFACTURE, ASSEMBLY AND ENVIRONMENTS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To know the concept of design for manufacturing, assembly and environment.
2.	To know the computer application in design for manufacturing and assembly.
3.	To know the environment friendly manufacturing methods.
4.	To improve knowledge on redesigning of castings.
5.	To understand the recycling and minimizing material usage methods.

UNIT - I	INTRODUCTION	9

General design principles for manufacturability - strength and mechanical factors, mechanisms selection, evaluation method, Process capability - Feature tolerances Geometric tolerances Assembly limits - Datum features - Tolerance stacks

UNIT - II	FACTORS INFLUENCING FORM DESIGN	9

Working principle, Material, Manufacture, Design- Possible solutions - Materials choice – Influence of materials on form design - form design of welded members, forgings and castings

UNIT - III	COMPONENT DESIGN - MACHINING CONSIDERATION	9

Design features to facilitate machining - drills - milling cutters - keyways - Doweling procedures, counter sunk screws - Reduction of machined area- simplification by separation – simplification by amalgamation - Design for machinability - Design for economy - Design for clampability – Design for accessibility - Design for assembly

UNIT - IV	COMPONENT DESIGN – CASTING CONSIDERATION	9

Redesign of castings based on Parting line considerations - Minimizing core requirements, machined holes, redesign of cast members to obviate cores. Identification of uneconomical design - Modifying the design - group technology - Computer Applications for DFMA

Approved by BoS Chairman

UNIT - V	DESIGN FOR THE ENVIRONMENT	9
Introduction – Environmental objectives – Global issues – Regional and local issues – Basic DFE methods – Design guide lines – Example application – Lifecycle assessment – Basic method – AT&T‟s environmentally responsible product assessment - Weighted sum assessment method Lifecycle assessment method – Techniques to reduce environmental impact – Design to minimize material usage – Design for disassembly – Design for recyclability – Design for remanufacture – Design for energy efficiency – Design to regulations and standards		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Select of material, manufacturing process and mechanism for a product.
CO2	Design a component by considering the form design and machining.
CO3	Design a component by considering machining process.
CO4	Design a component based on casting considerations.
CO5	Design an eco-friendly product.

Reference Books	
1.	Boothroyd, G , Dewhurst, P, and Knight, W, “Product Design for Manufacture and Assembly”, 3rd Edition, CRC Press,Taylor & Francis, 2010
2.	Bralla, James G, Design for Manufacturability handbook, McGraw hill, 1999.
3.	Boothroyd, G, Heartz and Nike, Product Design for Manufacture, Marcel Dekker, 1994.
4.	Dickson, John. R, and Corroda Poly, Engineering Design and Design for Manufacture and Structural Approach, Field Stone Publisher, USA, 1995.
5.	Fixel, J., “Design for Environment: A Guide to Sustainable Product Development”, 2nd Edition McGraw Hill, 2009.

Approved by BoS Chairman

M.E - E.D	M19EDE307 - ENGINEERING BIOMECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the principles of mechanics.
2.	To Learn the mechanics of physiological systems.
3.	To understand the various bio tissues.
4.	To understand the biomechanics of joints and implants.
5.	Be familiar with the mathematical models used in the analysis of biomechanical systems.

UNIT - I	INTRODUCTION TO MECHANICS	9

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagen-poiseuille equation, turbulent flow. Cardiovascular system - biological and mechanical valves development, artificial heart valves testing of valves, Structure, functions, material properties and modeling of Blood vessels

UNIT - II	BIOFLUID MECHANICS	9

Introduction, viscosity and capillary viscometer, Rheological properties of blood, laminar flow, Couette flow and Hagen - poiseuille equation, turbulent flow. Cardiovascular system - biological and mechanical valves development, artificial heart valves testing of valves, Structure, functions, material properties and modeling of Blood vessels

UNIT - III	BIOSOLID MECHANICS	9

Hard Tissues : Bone structure & composition mechanical properties of bone, cortical and cancellous bones, viscoelastic properties, Maxwell & Voight models – anisotropy. Soft Tissues: Structure, functions, material properties and modeling of Soft Tissues : Cartilage, Tendon, Ligament, Muscle

UNIT - IV	BIOMECHANICS OF JOINTS AND IMPLANTS	9

Skeletal joints, forces and stresses in human joints, Analysis of rigid bodies in equilibrium, free body diagrams, types of joint, biomechanical analysis of elbow, shoulder, spinal column, hip knee and ankle. Design of orthopedic implant, specifications for a prosthetic joint, biocompatibility, requirement of a biomaterial, characteristics of different types of biomaterials, manufacturing process of implants, fixation of implants

Approved by BoS Chairman

UNIT - V	MODELING AND ERGONOMICS	9
Introduction to Finite Element Analysis, Analysis of bio mechanical systems using Finite element methods, Graphical design. Ergonomics- Gait analysis, Design of work station, Sports biomechanics, Injury mechanics		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the mechanics of physiological systems.
CO2	Understand the various biofluid mechanics.
CO3	Explain the bone structure & composition mechanical properties of bone.
CO4	Design an orthopedic implant, specifications for a prosthetic joint.
CO5	Analyse the bio mechanical systems.

Reference Books

1. Marcelo Epstein, “The Elements of Continuum Biomechanics”, Wiley, ISBN : 978-1-119-99923-2, 2012.
2. Duane Knudson, “Fundamentals of Biomechanics”, Second Edition, Springer, 2007
3. Jay D. Humphrey, Sherry De Lange, “An Introduction to Biomechanics : Solids and Fluids, Analysis and Design”, Springer, 2004.
4. Shrawan Kumar, “Biomechanics in Ergonomics”, Second Edition, CRC Press 2007.
5. Y.C. Fung, “Bio-Mechanics- Mechanical Properties of Tissues”, Springer-Verlag, 2013.

Approved by BoS Chairman

M.E - E.D	M23EDE308 - COMPOSITE MATERIALS AND MECHANICS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand different composite materials and finding its mechanical strength.
2.	To Fabricate FRP and other composites by different manufacturing methods.
3.	To stress analysis of fiber reinforced Laminates for different combinations of plies with different orientations of the fiber.
4.	To calculate stresses in the lamina of the laminate using different failure theories.
5.	To calculate residual stresses in different types of laminates under thermo-mechanical load using the Classical Laminate Theory.

UNIT - I	INTRODUCTION TO COMPOSITE MATERIALS	9

Definition-Matrix materials-polymers-metals-ceramics - Reinforcements: Particles, whiskers, inorganic fibers, metal filaments- ceramic fibers- fiber fabrication- natural composite wood, Jute - Advantages and drawbacks of composites over monolithic materials. Mechanical properties and applications of composites, Particulate-Reinforced composite Materials, Dispersion-Strengthened composite, Fiberreinforced composites Rule of mixtures-Characteristics of fiber-Reinforced composites, Manufacturing fiber and composites

UNIT - II	MANUFACTURING OF COMPOSITES	9

Manufacturing of Polymer Matrix Composites (PMCs) - hand lay-up, spray technique, filament winding, Pultrusion, Resin Transfer Moulding (RTM), bag moulding, injection moulding, Sandwich Mould Composites (SMC) - Manufacturing of Metal Matrix Composites (MMCs) – Solid state, liquid state, vapour state processing, Manufacturing of Ceramic Matrix Composites (CMCs) – hot pressing - reaction bonding process - infiltration technique, direct oxidation - interfaces

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UNIT - III	INTRODUCTION, LAMINA CONSTITUTIVE EQUATIONS	9

Lamina Constitutive Equations : Lamina Assumptions – Macroscopic Viewpoint. Generalized Hooke's Law. Reduction to Homogeneous Orthotropic Lamina – Isotropic limit case, Orthotropic Stiffness matrix (Qij), Definition of stress and Moment Resultants. Strain Displacement relations. Basic Assumptions of Laminated anisotropic plates. Laminate Constitutive Equations – Coupling Interactions, Balanced Laminates, Symmetric Laminates, Angle Ply Laminates, Cross Ply Laminates. Laminate Structural Moduli. Evaluation of Lamina Properties from Laminate Tests. Quasi-Isotropic Laminates. Determination of Lamina stresses within Laminates

UNIT - IV	LAMINA STRENGTH ANALYSIS AND ANALYSIS OF LAMINATED FLAT PLATES	9

Introduction - Maximum Stress and Strain Criteria. Von-Misses Yield criterion for Isotropic Materials. Generalized Hill's Criterion for Anisotropic materials. Tsai-Hill's Failure Criterion for Composites. Tensor Polynomial (Tsai-Wu) Failure criterion. Prediction of laminate Failure Equilibrium Equations of Motion. Energy Formulations. Static Bending Analysis. Buckling Analysis. Free Vibrations – Natural Frequencies

UNIT - V	THERMAL ANALYSIS	9

Assumption of Constant Co-efficient of Thermal Expansion (C.T.E.) - Modification of Hooke's Law. Modification of Laminate Constitutive Equations. Orthotropic Lamina C.T.E's. C.T.E's for special Laminate Configurations – Unidirectional, Off-axis, Symmetric Balanced Laminates, Zero C.T.E laminates, Thermally Quasi - Isotropic Laminates

Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Explain the basic concepts of different types of Composites with its applications.
CO2	Choose appropriate composite fabrication techniques.
CO3	Develop models the mechanical behavior of Composites in both micro and macro level.
CO4	Evaluate the stresses in the lamina of the laminate using different failure theories.
CO5	Analyze thermo-mechanical behavior and evaluate residual stresses in different types of laminates.

Approved by BoS Chairman

Reference Books	
1.	Chung, Deborah D.L., “Composite Materials: Science and Applications”, Springer, 2nd Edition, 2012.
2.	Madhujit Mukhopadhyay, “Mechanics of Composite Materials and Structures”, University Press, 2005.
3.	Issac M. Daniel and Ori Ishai, “Engineering Mechanics of Composite Materials”, Oxford University Press - 2006, First Indian Edition – 2007.
4.	Mallick, P.K., “Fiber –Reinforced Composites: Materials, Manufacturing and Design”, 3rd Edition, CRC Press, 2007.
5.	Halpin, J.C., “Primer on Composite Materials, Analysis”, Routledge, Taylor & Francis, 2017.

Approved by BoS Chairman

M.E - E.D	M23EDE309 - DESIGN FOR INTERNET OF THINGS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge of concepts and terminology of Machine to Machine (M2M) to IoT.
2.	To learn functions and features of IoT structure.
3.	To understand different modules offered in M2M and IoT Technology.
4.	To understand IoT Architecture implementation approaches.
5.	To understand integration of IoT Reference Architecture with other applications.

UNIT - I	INTRODUCTION	9

Machine to Machine (M2M) to IoT - The Vision - Introduction, From M2M to IoT, M2M towards IoT - the global context, A use case example, Differing Characteristics

UNIT - II	IOT STRUCTURE	9

M2M to IoT – A Market Perspective – Introduction, Some Definitions, M2M Value Chains, IoT Value Chains, An emerging industrial structure for IoT, The international driven global value chain and global information monopolies. M2M to IoT - An Architectural Overview – Building an architecture, Main design principles and needed capabilities, An IoT architecture outline, standards considerations

UNIT - III	IOT NETWORKING	9

M2M and IoT Technology Fundamentals - Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics, Knowledge Management

UNIT - IV	IOT ARCHITECTURE	9

IoT Architecture - State of the Art – Introduction, State of the art, Architecture Reference Model - Introduction, Reference Model and architecture, IoT reference Model

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UNIT - V	ARCHITECTURE MODELING	9
IoT Reference Architecture - Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant architectural views. Real - World Design Constraints- Introduction, Technical Design constraints-hardware is popular again, Data representation and visualization, Interaction and remote control. Industrial Automation - Service - oriented architecture-based device integration, SOCRADES : realizing the enterprise integrated Web of Things, IMC-AESOP: from the Web of Things to the Cloud of Things, Commercial Building Automation - Introduction, Case study : phase one - commercial building automation today, Case study: phase two - commercial building automation in the future		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Understand the vision of IoT from a global context.
CO2	Determine the Market perspective of IoT.
CO3	Use of Devices, Gateways and Data Management in IoT.
CO4	Build state of the art architecture in IoT.
CO5	Apply of IoT in Industrial and Commercial Building Automation and Real-World Design Constraints.

Reference Books	
1.	Francis daCosta, “Rethinking the Internet of Things : A Scalable Approach to Connecting Everything”, 1st Edition, A press Publications, 2013.
2.	Jan Holler, Vlasios Tsiatsis, Catherine Mulligan, Stefan Aves and, Stamatis Karnouskos, David Boyle, “From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence”, 1st Edition, Academic Press, 2014.
3.	Vijay Madisetti and Arshdeep Bahga, “Internet of Things (A Hands-on-Approach)”, 1st Edition, VPT, 2014.

Approved by BoS Chairman

M.E - E.D	M23EDE310 - HUMAN FACTORS ENGINEERING IN PRODUCT DESIGN	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand the concept of ergonomic design.
2.	To design the work environment and equipments
3.	To analyse the human performance and set standard.
4.	To design information display and control for a system.
5.	To understand the concept occupational safety in product design.

UNIT - I	INTRODUCTION & DESIGN TO FIT TASKS, PROCESSES, AND PEOPLE	9

Introduction - Ergonomic Design - Human-Centered Design - Ergonomic Criteria - Models of Human Performance - Macro-ergonomics - Ergonomic Methods - Ergonomic Design Principles - Visual Graphs of Operations - Analysis of Tasks and Jobs

UNIT - II	DESIGN OF THE PHYSICAL ENVIRONMENT, WORK AREAS, TOOLS AND EQUIPMENT	9

Cleanliness, Clutter, and Disorder - Temperature and Humidity - Lighting and Illumination - Noise – Applied Anthropometry - Design of Work Areas and Stations - Design of Tools and Equipment – Protective Equipment for the Operator

UNIT - III	DESIGN & ANALYSIS OF PHYSICAL TASKS - MEASURING & PREDICTING HUMAN PERFORMANCE – LEARNING CURVE	9

Methods Improvement - Motion and Micro-motion Study - Manual Materials Handling – Probabilistic Assumptions - Time Study - Performance Leveling - Determining Allowances - Maintaining Standards - Indirect Performance Measurement - Criteria Other Than Time - Synthetic Data Systems - Standard Data Systems - Cognitive Modeling - Learning Curve Models - Fitting Learning Curves

UNIT - IV	DESIGN OF COMMUNICATION, DISPLAY & CONTROL	9

Communication Theory - Human Information Processing - Display Design - Hazard Communication - Control Systems - Manual Control - Design of Controls - Fuzzy Control - Supervisory Control

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UNIT - V	DESIGN OF PRODUCT QUALITY & MACRO-ERGONOMICS OF OCCUPATIONAL SAFETY AND HEALTH	9
Quality Management and Customer-Driven Design - Usability Analysis and Testing – Designed Experiments - Fundamental Concepts of Industrial Safety and Health - Contemporary Occupational Health and Safety Management - Hazards and Control Measures - Warnings and Safety Programs		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Apply the fundamental concepts and principles of ergonomics in product design and development.
CO2	Apply the principles of work place design & equipment design in product design and development.
CO3	Apply the principles of physical task design in product design and development. Apply the measurement and prediction methods of human performance with relation to learning curve theory in product design and development.
CO4	Apply the principles of communication, display & control design in product design and development.
CO5	Apply the principles of product quality in product design and development. Apply the principles of macro-ergonomics of occupational safety and health.

Reference Books	
1.	Mark R. Lehto & James R. Buck, “Introduction to Human Factors & Ergonomics for Engineers”, CRC Press, Taylor & Francis, 2008.
2.	Chandler Allen Phillips, “Human Factors Engineering”, John Wiley and sons, New York, 2000
3.	Mark S Sanders, “Human Factors in Engineering and Design”, McGraw Hill, New York,1993.
4.	Martin Helander, “A guide to Human Factors and Ergonomics”, 2nd Edition, CRC, Taylor & Francis Group 2006.
5.	McCormik, J., “Human Factors Engineering and Design”, McGraw Hill, 1992.

Approved by BoS Chairman

M.E - E.D	M23EDE311 - PRODUCT LIFECYCLE MANAGEMENT	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To understand history, concepts and terminology of PLM.
2.	To understand functions and features of PLM/PDM.
3.	To understand different modules offered in commercial PLM/PDM tools.
4.	To understand PLM/PDM implementation approaches.
5.	To explore the possibility of digital manufacturing in practical applications.

UNIT - I	HISTORY, CONCEPTS AND TERMINOLOGY OF PLM	9

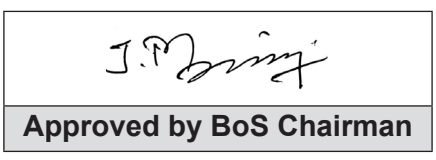
Introduction to PLM, Need for PLM, opportunities of PLM, Different views of PLM – Engineering Data Management (EDM), Product Data Management (PDM), Collaborative Product Definition Management (cPDm), Collaborative Product Commerce (CPC), Product Lifecycle Management (PLM). PLM/PDM Infrastructure – Network and Communications, Data Management, Heterogeneous data sources and applications

UNIT - II	PLM / PDM FUNCTIONS AND FEATURES	9

User Functions – Data Vault and Document Management, Workflow and Process Management, Product Structure Management, Product Classification and Programme Management. Utility Functions – Communication and Notification, data transport, data translation, image services, system administration and application integration

UNIT - III	DETAILS OF MODULES IN A PDM / PLM SOFTWARE AND DIGITAL LIFE CYCLE	9

Case studies based on top few commercial PLM/PDM tools - Collaborative Product Development, Mapping Requirements to specifications. Part Numbering, Engineering Vaulting, Product reuse, Engineering Change Management, Bill of Material and Process Consistency. Digital Mock up and Prototype development. Virtual testing and collateral. Introduction to Digital Manufacturing



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UNIT - IV	ROLE OF PLM IN INDUSTRIES	9
Case studies on PLM selection and implementation (like auto, aero, electronic) - other possible sectors, PLM visioning, PLM strategy, PLM feasibility study, change management for PLM, financial justification of PLM, barriers to PLM implementation, ten step approach to PLM, benefits of PLM for – business, organisation, users, product or service, process performance		

UNIT - V	PLM DIGITAL MANUFACTURING	9
Digital Manufacturing – PLM Digital manufacturing, benefits manufacturing, manufacturing the first-one, Ramp up, virtual learning curve, manufacturing the rest, production planning		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Outline history, concepts and terminology of PLM.
CO2	Apply the functions and features of PLM / PDM.
CO3	Make use of different modules offered in commercial PLM / PDM tools.
CO4	Outline PLM/PDM implementation approaches.
CO5	Realize potential for digital manufacturing in contemporary manufacturing applications.

Reference Books	
1.	John Stark, “Product Lifecycle Management: 21st Century Paradigm for Product Realisation”, Springer Publisher, 2011 (2nd Edition).
2.	Antti Saaksvuori and Anselmi Immonen, “Product Lifecycle Management”, Springer Publisher, 2008 (3rd Edition).
3.	Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
4.	John Stark, “Global Product : Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007.

Approved by BoS Chairman

M.E - E.D	M23EDE312 - COST MANAGEMENT OF ENGINEERING PROJECTS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	To outline the need for Project Management.
2.	To highlight different techniques of activity planning.
3.	To know the basic structure of pricing.
4.	To study and understand the concept of Engineering Economics and apply in the real word.
5.	To gain knowledge in the field of cost estimation and enable the students to estimate the cost of

UNIT - I	INTRODUCTION TO PROJECT MANAGEMENT	9

Objectives of Project Management - Importance of Project Management - Types of Projects Project Management Life Cycle - Project Selection – Feasibility study : Types of feasibility Steps in feasibility study

UNIT - II	PROJECT PLANNING AND IMPLEMENTATION	9

Project Scope - Estimation of Project cost – Cost of Capital – Project Representation and Preliminary Manipulations - Basic Scheduling Concepts - Resource Levelling – Resource Allocation

UNIT - III	PRICING	9

Determinants of price – Pricing under different objectives – Pricing under different market structures – Price discrimination – Pricing of Joint products – Pricing methods in practice

UNIT - IV	PRODUCTION AND COST ANALYSIS	9

Production Analysis – Production function, Returns to a factor, Returns to scale, ISO quants and Least cost combination of inputs. Cost Analysis – Cost concepts, Determinants of cost, Short - run cost - output Relationship, Long - run cost output relationship, Economies and Diseconomies of scale and Estimating cost – Output Relationship

Approved by BoS Chairman

UNIT - V	ESTIMATION OF COST MANAGEMENT	9
Introduction to Estimation and Costing – Elements of costs – Allocation of overheads – Estimation of Material cost – Estimation of Labour cost, - Estimation in Machine shop – Estimation in Sheet metal shop – Estimation in Forging shop – Estimation in welding shop – Estimation in Foundry shops		
Total Instructional hours : 45		

Course Outcomes : Students will be able to	
CO1	Explain the concept of projects, its process, objectives and functions of project management.
CO2	Discuss the functions of project management.
CO3	Apply project management principles in business situations to optimize time and resource utilization.
CO4	Apply the principles of micro economics and cost estimation.
CO5	Apply the principles to appreciate the functioning of product and input market as well as the economy.

Reference Books	
1.	Arun Kanda, “Project Management A Life Cycle Approach”, Prentice Hall of India, 2011.
2.	R.B. Khanna, “Project Management”, Prentice Hall of India, 2011.
3.	R. Panneerselvam and P. Senthilkumar, “Project Management”, Prentice Hall of India, 2009.
4.	T.R. Banga and S.C. Sharma, Mechanical Estimating and Costing, 17th Edition, Khanna Publishers, 2001.
5.	V.L. Mote, Samuel Paul and G.S. Gupta, Managerial Economics – concepts and cases, Tata McGraw-Hill, 40th reprint 2007.

Approved by BoS Chairman

Semester - IV

M.E - E.D	M23EDP401 - PROJECT WORK PHASE - II	L	T	P	C
		0	0	24	12

Course Objectives	
1.	To solve the identified problem based on the formulated methodology.
2.	To develop skills to analyze and discuss the test results, and make conclusions.

Description of the Experiments

The student should continue the phase I work on the selected topic as per the formulated methodology under the same supervisor. At the end of the semester, after completing the work to the satisfaction of the supervisor and review committee, a detailed report should be prepared and submitted to the head of the department. The students will be evaluated based on the report submitted and the viva-voce examination by a panel of examiners including one external examiner

Total Instructional hours : 360

Course Outcome

Design calculations and analysis on completion of the project work students will be in a position to take up any challenging practical problem in the field of engineering design and find better solutions to it

Approved by BoS Chairman