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.

M.E. – Engineering Design

(R - 2019)

REGULATIONS, CURRICULUM & SYLLABI – 2019

(For the students admitted during 2019 - 2020 and onwards)

Master of Engineering
in
Engineering Design

Curriculum and Syllabi
I to IV Semesters

Vision	
◎	To enrich the students into a knowledgeable professionals and take a leading edge as a proficient Mechanical Engineers and Entrepreneurs to create a paradigm shift in their technical fields.

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.

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.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 FOUR 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.B.A / M.C.A., degree programs at this Institute from Academic year 2019 - 2020.

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.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.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.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.B.A/ M.C.A., Programme.
2.	**Discipline**	Refers to specialization or branch of M.E. Degree
3.	**Course**	Refers to a theory or practical subject that is normally studied in a semester, like Applied Mathematics etc.,
4.	**Head of the Institution**	Refers to the Principal of the College.
5.	**Controller of Examinations (CoE)**	Refers to the authority of the college who is responsible for all activities of the Semester End Examinations.
6.	**Head of the Department**	Refers to the Head of the Department concerned.
7.	**University**	Refers to Anna University, Chennai.

8.	**College**	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.	**T– P – TU – C**	Refers to Theory, Practical, Tutorial, and Credits respectively.
11.	**Foundation Courses (FC)**	may include Mathematics or other basic courses
12.	**Professional Core (PC)**	Courses include the core courses relevant to the chosen specialization/branch.
13.	**Professional Elective (PE)**	Courses include the elective courses relevant to the chosen specialization/ branch.
14.	**Employability Enhancement Courses(EEC)**	Includes Project Work and/or Internship, Seminar, Professional Practices, Case Study and Industrial/ Practical Training.
15.	**Academic Evaluation Committee (AEC)**	The committee includes Principal, CoE, HoD concerned
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.

4. ADMISSION

4.1 Candidates seeking admission to M.E. / 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.

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.

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

M.E. / M.B.A / M.C.A. Programmes under the Faculty of Civil Engineering, Faculty of Mechanical Engineering, Faculty of Electrical Engineering, Faculty of Information and Communication Engineering and Faculty of Technology. KIT offers 2 year (4 Semesters) M.E../M.B.A., and 3 year (6 Semesters) M.C.A., Degree programme affiliated to Anna University, under Choice Based Credit System (CBCS) for students admitted from 2019 onwards in the following branches of Engineering and Technology as in Table 1.

Table 1. List of B.E. / B.Tech. programmes offered

M.E., Applied Electronics
M.E., VLSI Design
M.E., Engineering Design
M.E., Computer Science and Engineering
M.E., Power Systems and 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. **Employability Enhancement Courses (EEC)** include Project Work and/or Internship, Seminar, Professional Practices, Summer Project, Case Study and Industrial / Practical Training.

Instead of two electives in the curriculum, the student may be permitted to choose a maximum of 2 courses from other PG programmes with the approval of the Head of the Department offering such courses.

6.3 Number of courses per semester

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

6.4 Credit Assignment

Each course offered is given a T-P-TU-C structure, depending on the number of lecture periods (T), number of periods for practical (P) and number of tutorial periods (T) required per week 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 T-P-TU-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 4 : Credit Assigned

Contact period per week	Credits
1 Lecture Period (**T** = Lectures given during class by the faculty)	1
1 Tutorial Periods (**TU** = Tutorial, also class based with more emphasis on problem solving)	1
2 Practical Period (**P**) (Laboratory Periods / CEC / Projects)	1

6.5 Industrial Training / Internship

The students may undergo Industrial training for a period as specified in the curriculum during summer / winter vacation. In this case the training has to be undergone continuously for the entire period.

The students may undergo Internship at Research organization / University (after due approval from the Department Consultative Committee) for the period prescribed in the curriculum during summer / winter vacation, in lieu of Industrial training.

6.6 Value added Courses

The Students may optionally undergo Value Added Courses and the credits earned through the Value Added Courses shall be over and above the total credit requirement prescribed in the curriculum for the award of the degree. One / Two credit courses shall be offered by the Department with the prior approval from the Head of the Institution. The details of the syllabus, time table and faculty may be sent to AEC and the Controller of Examinations after approval from the Head of the Institution concerned atleast one month before the course is offered. Students can take a maximum of two one credit courses / one two credit course during the entire duration of the Programme.

6.7 Online Courses

Students may be permitted to register for online courses (which are provided with certificate after evaluation of the performance, SWAYAM/NPTEL), during third to sixth semester of his/her study. On successful completion of the course, he/she has to submit the copy of the certificates to the Head of the Department. The assemment will not be calculated for CGPA.

6.8 Course Numbering Scheme

Each course is denoted by a unique code consisting of 10 alphanumeric characters. The details of the numbering scheme are in APPENDIX A.

6.9 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	Prescribed Credit Range
M.E. / M.Tech.	

Programme	Prescribed Credit Range
M.C.A.	
M.B.A.	

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. / M.Tech. (Full-Time)	4	8
M.C.A. (Full Time)	6	12
M.B.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.

7.4 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 Continous Assessment Marks and appear for the Semester End Examination (SEE).

8.2 Credits details for Course Registration

A student has to earn the total 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, then he/she is permitted to earn more than the total number of credits prescribed in the curriculum.

The number of credits, most students are expected to register for, in a semester, will be about 22-26 credits, so that they complete the programme within the specified duration of the programme. The minimum credits a student can register for, in a regular semester shall be 16.

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 the study in order to be eligible to obtain the degree. From semester 3 to 8, the student has the options for dropping an existing course. The total number of credits that a student can drop is limited to 6. Practical courses cannot be dropped.

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.

8.43 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 8 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 FOR CIA AND SEE

9.1 A student who has fulfilled the following conditions shall be deemed to be eligible to appear for the CIA-1, Midsem, CIA-3 and SEE. Ideally, every student is expected to attend all the classes and earn 100% attendance. Students who have earned not less than 75% attendance course wise taking into account the number of periods required for that course as specified in the curriculum. Table 5 illustrates the mandatory attendance requirement for CIAT-1, Midsem, CIA-3 and SEE.

Test / Examination Type	Period of Calculation	Max. No. of Semesters
Continuous Assessment Test 1 (CIA - 1)	**First Semester** From the date of joining of course to three working days before the start of CIA -1	60%
	Second to Eighth semester From the date of commencement of the course to one week before the start of CIA - 1	75%

Midsem Exam	From the date of joining (1st semester) / date of commencement of course (2nd to 4th / 6th Semester) to one week before the start of Midsem Exam	75% (for students maintaining 80% or more attendance between CIA 1 and Midsem Exam, but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)
Continuous Assessment Test 3 (CIA - 3)	From the date of joining (1st semester) / date of commencement of course (2nd to 4th / 6th Semester) to one week before the start of CIA - 3	75% (for students maintaining 80% or more attendance between Midterm Exam and CIA 3, but falls short of the 75% cumulative requirement, the requirement may be relaxed if recommended by the AEC)
End Semester Examination (SEE)	From the date of joining (1st semester)/date of commencement of course (2nd to 4th/6th Semester) to the last day of instruction.	75%

9.1.1 A student shall normally be permitted to appear for End semester examination of the course if he / she has satisfied the attendance requirements (vide Clause - 9.1). He / she is eligible to register for SEE in that semester by paying the prescribed fee.

9.1.2 Students who have earned attendance less than 75% in a course will not be permitted to appear for Semester End Examination for that course. The student has to register and repeat the particular course in a subsequent semester when it is offered next. However, exemption may be given for the students who earned attendance between 65% and less than 75% in a particular course from the prescribed attendance requirement based on medical leave and On Duty Leave(ODL) with prior approval from the Principal / competent authority.

9.1.3 If a student has lack of attendance in 2 or more courses which are 3 or 4 credit courses (1 credit courses not taken into account) offered in a particular semester. He / she will be detained in that semester and hence cannot proceed to the next semester. He / she shall seek re-admission as per the norms of the affiliating university / DOTE (Directorate of Technical Education). However, in cases of absence due to genuine reasons, he/she may apply to the CoE, for revocation of detainment. The committee composition and the process are as in Appendix IV. The Committee's decision is final.

9.1.4 The students who are consistently good in academics ONLY be considered for the grant of ODL under Co-curricular activities by the competent authorities. The following activities shall be considered for the sanction of ODL;

- Sports and Games: TIES, Inter Collegiate, Inter Zonal, Inter University, State Level, National Level and Open Tournaments.
- NCC: Camps and expeditions, NSS camps
- Cultural Programme at State, National and International Level
- Seminar / Symposia: Paper presentation / Quiz
- Leadership courses organized by other organizations & Alumni Association activities, Association activities, Placement activities.
- Training programs/Internship at industries and Higher learning Institutions
- Personal damage incurred during the extracurricular activities
- The ODL requisition letter shall be forwarded to the Principal through the HoD of the student by the staff-in-charge of the respective activities before completion of every activity.
- The ODL sanctioned letters shall be submitted to the Department Office. The faculty-in-charge of the department office will check the eligibility for the award of attendance at the end of semester and the same may be submitted to DEC for approval.

9.1.5 The student should register all the courses of current semester and all the arrear courses in the previous semesters. If any student fails to register and pay the examination fees within the due date, he/she shall not be permitted to attend the semester end examinations. However, he/she will be permitted to continue their studies in the next higher semester, provided that the student satisfies the requirements as stipulated in this clause of this regulation.

9.1.6 Those students who are not deemed to have completed the semester with references to the conditions specified above shall undergo the semester again in all the courses in the respective semester during next academic year. He/she shall seek re-admission as per the norms of the affiliating University/DOTE (Directorate of Technical Education).

The days of suspension for a student on disciplinary grounds will be considered as days of absence for calculating the percentage of attendance for each individual course.

9.1.7 Supplementary Examination

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

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 Semester End 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 SEE 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 19) 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.

12. REMEDIAL MEASURES FOR ABSENCE / FAILURE IN MIDSEM

12.1 Absence from the MIDSEM

No Retest will be conducted. A student who has not appeared for a Midsem (theory courses) shall be permitted to be eligible for re-scaling subject to DEC and AEC approval. The student shall apply to the DEC and the AEC will approve the application for eligibility rescaling only for the following reasons:

- Absence due to prolonged illness of more than 7 working days or due to hospitalization (in-patient treatment)
- Absence due to death of immediate family members
- Absence due to participation in NCC/NSS/NSO camp's only
- Absence due to participation and representation of college in Government conducted sports events, National level design competitions and off-campus placements with prior approval

For genuine cases, recommended by DEC, Rescaling of ESM for the missed CIA will be done as follows:

Missed MIDSEM Mark = 80 % of ESM

12.2 Failure in MidSem

Students scoring < 50% in Midsem exam will be permitted to improve their marks by up to 10 marks by submitting assignments before the start of CIA-3.

13. ASSESSMENT PROCEDURES FOR AWARDING MARKS

The total marks for each course generally (Theory, Practical, Project Work) will be 100, comprising of two components namely Continuous Internal Assessment (CIA) and Semester End Examination (SEE). However, there could be some open elective courses, human excellence courses, one credit industry courses, add-on courses and Mandatory courses that have only continuous assessment for 100 marks without an End-Semester Examination. The Department Consultative Committee (DCC) has to approve such courses every semester. The scheme of assessment may also be decided by the faculty handling the course concerned with the approval from DCC and shall be made available to the students during the online course registration. Each course shall be evaluated for a maximum of 100 marks as illustrated in Table 6.

Table 6 : Course Evaluation

S. No.	Category of course	Continuous Internal Assessment	Semester End Examinations
1.	Theory Courses	40 Marks	60 Marks
2.	Laboratory Courses		
3.	Project Work		
4.	CCA (Technical Seminar / Soft Skill / Industry oriented one credit courses)	100 Marks	–

The Semester End Examination (theory and practical) of 3 hours duration shall ordinarily be conducted between October and December during the odd semesters and between April and June during the even semesters.

The Semester End Examination for project work shall consist of evaluation of the final report submitted by the student or students of the project group (of not exceeding 4 students) by an external examiner and an internal examiner, followed by a viva-voce examination conducted separately for each student by a committee consisting of the external examiner, the supervisor of the project group and an internal examiner.

For the Semester End Examination in both theory and practical courses including project work the internal and external examiners shall be appointed by the Controller of Examinations..

14. MARKS DISTRIBUTION

14.1 Attendance Mark

Marks are awarded for the attendance earned by the students for individual courses as per the following table.

Attendance Range in %	Marks to be earned by the students
96 - 100	5
91 - 95	4
86 - 90	3
81 - 85	2
75 - 80	1

14.2 Question paper pattern

a. Table 7.1 Continuous Internal Assessment (CIA 1, CIA -2 and CIA-3)

2 Marks	12 Marks	Total marks
7	3 (3 out of 5)	50

b. Table 7.2 Midsem and Semester End Examinations

2 Marks	13 Marks	15 marks	Total Marks
10	5 (Either or Type)	1 (Either or Type)	100
For Mathematics paper only			
2 Marks	16 Marks		Total Marks
10	5		100

14.3 Theory Courses

Continuous Internal Assessment tests are conducted by the Office of the Controller of Examination. Continuous Internal Assessment comprises three Continuous assessment tests, Assignment / Class test / Presentation / Online Test / Mini projects / Tutorials and Attendance. By adopting this method, the students will go through a continuous and systematic study pattern. The Corresponding weightages are given below.

Table 8 : Continuous Assessment Test for UG Theory Courses

Particulars	Syllabus	Duration	Exam Mark	Internal Mark	
Continuous Internal Assessment 1	1.5 Units	1.5 hours	50 marks	10	20 (Best of Two CIA)
Continuous Internal Assessment 2	1.5 Units	1.5 hours	50 marks	10	
Continuous Internal Assessment 3	1.5 Units	1.5 hours	50 marks	10	
Mid sem Exam	3.5 Units	3 hours	100 marks	10	
Assignment / Class Test / Online Test / Mini Project / Tutorial / Presentation / Online course / Certificate Course				5	
Attendance				5	
Total				40	

14.3 Criteria for Assessment for Lab Courses

Every exercise / experiment in all practical courses shall be evaluated on a continuous basis. The criteria for Continuous Assessment (for each cycle of exercise/experiment) are given in Table 9.

Table 9 : Assessment for Lab Courses

Sl. No.	Description		Weightage
1.	Continuous Internal Assessment Marks (CIAM)		
	a.	Average of Experimental Report / Workbook	25
	b.	Model examination	10
	c.	Attendance	5
	Total CIAM		**40**
2.	Semester End Exam Marks (SEEM)		
	a.	Lab Examination with Viva Voce	60
	Total ESM		**60**
		Total Marks	**100**

14.4 PROJECT WORK

For Project Work (Phase I & II) out of 100 marks, the maximum marks for Continuous Assessment is 40 marks and that for the End Semester Examination (project report evaluation and viva-voce examination) is 60 marks. Project work may be assigned to a single student or to a group of students not exceeding 4 per group, under the supervision of faculty guide(s).

The Head of the Department shall constitute a review committee for each programme. There shall be a minimum of three faculty members in the review committee. There shall be three reviews (as per Table 10) in total, during the semester by a review committee. The student shall make presentation on the progress made before the committee.

Interim project report shall be submitted before the project reviews with the approval of the guide. The Project Report, prepared according to the approved guidelines and duly signed by the guide and the Head of the Department, shall be submitted to the department as per the timeline announced by the department. The End Semester Examination for project work shall consist of evaluation of the final project report by an external examiner, followed by a viva-voce examination conducted separately for each student, by a committee consisting of the external examiner, and an internal examiner. The Controller of Examinations (CoE) shall appoint Internal and External Examiners for the End Semester Examination of the Project Work.

The Continuous Internal Marks (CIM) and Semester End marks (SEM) for Project Work and the Viva-Voce Examination will be distributed as indicated in Table 10.

Table 10 : CIM and SEM break-up for project work

Sl.No.	Review No.		Description	Marks	Total Marks
1.	**Continuous Assessment Marks**				
	a.	Review 1	Review Committee	5	10
			Guide	5	
	b.	Review 2	Review Committee	7	15
			Guide	8	
	c.	Review 3	Review Committee	7	15
				8	
Total CAM					**40**
2.	**Semester End Examinations Marks**				
	a.	Evaluation of final report and viva-voce	Internal Examiner	10	**50**
			External Examiner	40	
	b.	Outcome*	Publication of papers / prototype / patents etc.,	10	10
Total ESM					**60**
Total Marks					**100**

Review committee consists of internal faculty members nominated by the Head of the Department. The guide of student being examined shall not be part of the committee.

* Outcome – in terms of paper publication, patents, product development and industry projects shall be awarded by both internal and external examiners, based on the document proofs submitted by the student concerned.

If a student fails to submit project report / does not appear for the SEE /fails in the Semester End Examination (SEE)/ fails in Continuous Internal assessment (CIA) he/she is deemed to have failed in the project work and shall have to re-register for the same when offered next.

15. PASSING REQUIREMENTS

15.1 A student is declared to have successfully passed a theory based course if he/she has secured:

- A minimum of 50% marks in the semester end examinations.
- A minimum of 50% marks on combining both Continuous Assessment Marks (CAM) and Semester End Examination Marks (SEEM).

15.2 A student is declared to have successfully passed a practical / project based course if he / she has secured:

- A minimum of 50% marks in the semester end examinations.
- A minimum of 50% marks on combining both Continuous Assessment Marks (CAM) and Semester End Examination Marks (SEEM).

15.3 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 .

15.4 For a student who is absent for end-semester theory / practical / project viva-voce, the term “RA-AB” 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. .

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

15.6 For mandatory courses (non-credit), the student must satisfy the minimum attendance requirement & passing criteria as specified for the course as detailed in Section 17.2

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 11 : Grievance Redressal Mechanism

Sl. No.	Redressal Sought	Methodology	
		Regular Exam	Arrear Exam
1.	Revaluation	⦿ Apply for photo copy of answer book ⦿ Then apply for revaluation after course expert recommendation	

2.	Challenge of Evaluation	⊙ Apply for photo copy of answer book ⊙ 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.		

Challenge of Evaluation – Flow Process

Table 12 : 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 photocopy 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.

17. LETTER GRADE

Absolute grading system is adopted in converting marks to grads

17.1 Absolute Grading Policy

All assessments of a course will be evaluated on absolute marks basis. However, for the purpose of reporting the performance of a candidate, letter grades, each carrying certain number of points, will be awarded as per the range of total marks (out of 100) obtained by the candidate in each subject as detailed below:

Table 13 : Absolute Grading – Letter Grade and its Range

Sl.No.	Range of percentage of total marks	Letter Grade	Grade Points
1.	91 - 100	O (Outstanding)	10
2.	81 – 90	A+ (Excellent)	9
3.	71 – 80	A (Very Good)	8
4.	61 – 70	B+ (Good)	7
5.	50 – 60	B (Average)	6
6.	<50	RA (Re-appearance)	0

7.	Shortage of attendance	RA - SA (Re-appearance due to shortage of attendance)	0
8.	Absent	RA – AB (Re-appearance due to absence)	0
9.	Withdrawal from examination	W	0
10.	Pass in Mandatory non-credit courses	P	0
11.	Fail in Mandatory non-credit courses	F	0

A student is deemed to have passed and acquired the corresponding credits in a particular course if he/she obtains any one of the following grades: “O”, “A+”, “A”, “B+”,“B”. ‘RA’ indicates that Reappearance is mandatory for that course concerned. ‘SA’ denotes shortage of attendance (as per Clause 10) and hence prevented from writing the Semester End Examination. P and F are grades for mandatory, but non-credit courses.

17.2 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.

17.2.1 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.

17.2.2 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.

17.2.3 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 Semester Grade Point Average (SGPA) for the semester.
- The Cumulative Grade Point Average (CGPA) of all courses enrolled from first semester onwards.

On completion of a semester, each student is assigned a Semester Grade Point Average which is computed as below for all courses registered for, by the student during that semester.

$$\text{Semester Grade Point Average} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

where C_i is the credit for a course in that semester and 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 Cumulative Grade Point Average (CGPA) up to that point of time.

$$\text{Cumulative Grade Point Average} = \frac{\sum(C_i \times GP_i)}{\sum C_i}$$

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

17.2.4 FORMULA FOR CALCULATING PERCENTAGE

CGPA X 10 = % of Marks

18. ELIGIBILITY FOR THE AWARD OF DEGREE

A student shall be declared to be eligible for the award of the M.E / MBA / MCA. 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 -Semester End examinations and passed all the subjects prescribed in all the semesters within a maximum period of 7 years and 6 years in the case of Lateral Entry reckoned from the commencement of the first (third in the case of Lateral Entry) semester to which the candidate was admitted.

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 2019 (R19) (vide Clause 4.3)

v. No disciplinary action pending against the student.

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

19. CLASSIFICATION OF M.E / MBA / MCA DEGREE

The degree awarded to eligible students will be classified as given in Table 14.

Table 14 : Classification of the M.E / MBA / MCA 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.** › 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 (vide Clause 18) 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 Semester end examination due to lack of attendance in any of the courses **M.C.A** › Should have passed the examination in all the courses of all the six semesters in the student's First Appearance within four years, which includes authorised break of study of one year (if availed). Withdrawal from examination (vide Clause 18) 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** › 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 7.00. **M.C.A** › Should have passed the examination in all the courses of all six semesters within four 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 7.00.

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 semester endr 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 semester end examinations as per Clause 9) for the purpose of classification.		

20. AWARD OF DEGREE

The Academic Council of the institution will approve the award of Degree to all eligible students. The degree will be issued by Anna University, Chennai and the consolidated Grade Sheet will be issued by the institution. The consolidated grade sheet will specify any specializations and distinctions that the student has earned during the course of the study.

21. FACULTY MENTOR

To help the students in palnning their courses of study and for general advice on the academic progarmme, the Head of the Department will attach a certain number of students (maximum 20) 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 Head of the Department or in Parent-Teacher meeting.

22. 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 Head of the Department shall coordinate the activities of this committee.

- The class committee shall be constituted by the Head of the Department/Chief Tutor 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 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 Head of the Department within five working days of the meeting. Head of the Department will in turn consolidate and forward the same to the Principal, within 10 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.

23. 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 continuous assessment tests. The question paper for the end semester examination is common and shall be set by the Course Coordinator in consultation with all the teachers or the external member as appointed by the Controller of Examinations.

24. 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, Midsem 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 and assessment of both current and previous semesters.

25. 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 University or Institution. The Principal shall refer any act of indiscipline by students to the Discipline and Welfare Committee and other appropriate committees for action.

26. REVISION OF REGULATIONS AND CURRICULUM

The institution may from time to time revise, amend or change the Regulations, scheme of Examinations and syllabi, if found necessary. Academic Council assisted by Board of Studies and Standing Committee will make such revisions / changes.

Note : Any ambiguity in interpretation of this regulation is to be put up to the Standing Committee, whose decision will be final.

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	9
Programme	Regulation		Department Code		Course Type	Semester	Course Mode	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	**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 5 - Fifth Semester 6 - Sixth 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 (This is the best method of tackling this malady)

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 external 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 Controller of Examinations, 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.

ANNEXURE - 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 cell phones/ programmable calculator(s) / any other electronic storage device(s) gadgets	Invalidating the examination of the particular subject written by the candidate
10.	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.	
11.	The candidate possessing cell phone(s)/ programmable calculator(s)/any other electronic storage device(s) gadgets and containing incriminating materials (whether used or not).	

12.	The Candidate possessing the question paper of another candidate with additional writing on it.	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.
13.	The candidate passing his/her question paper to another candidate with additional writing on it	
14.	The candidate passing incriminating materials brought into the examination hall in any medium (hard/soft) to other candidate(s).	
15.	The candidate copying from neighbouring candidate.	
16.	The candidate taking out of the examination hall answer booklet(s), used or unused	
17.	Appeal by the candidate in the answer script coupled with a promise of any form of consideration.	
18.	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.

19.	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.
20.	The candidate possessing the answer script of another candidate	
21.	The candidate passing his /her answer script to another candidate	
22.	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 subjects of the current semester and 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.
23.	The candidate substituting an answer book let prepared outside the examination hall for the one already distributed to the candidate	
24.	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.	Invalidating the examinations of all the theory and practical subjects of the current semester and 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 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-subjects for four subsequent semesters.
25.	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.	
26.	Candidate possessing any firearm/weapon inside the examination hall.	

27.	Cases of Impersonation	(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 of this University 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 of the University. 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 of the University.

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.

Curriculum

Scheme of Assessment and Examinations

(For Students admitted from the Academic Year 2019-20 and onwards)

Semester - I

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
Induction Programme											
M19MAT103	Applied Mathematics for Engineers	**BS**	4	3	0	1	**3**	40	60	100	**4**
M19EDT101	Design of Material Handling Equipments	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT102	Computer Applications in Design	**PC**	3	3	0	1	**3**	40	60	100	**3**
M19EDT103	Quality Concepts in Design	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT104	Advanced Finite Element Analysis	**PC**	4	3	0	1	**3**	40	60	100	**4**
	Professional Elective I	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDP101	CAD Laboratory	**PC**	3	0	3	0	**3**	40	60	100	**2**
M19EDP102	Advanced Analysis and Simulation Laboratory	**PC**	3	0	3	0	**3**	40	60	100	**2**
Total Contact Hours/Week			**26**	**18**	**6**	**2**	**Total Credits**				**24**

Semester - II

Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19EDT201	Surface Engineering	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT202	Mechanical Behavior of Materials	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT203	Integrated Mechanical Design	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT204	Vibration Analysis and Control	**PC**	3	3	0	0	**3**	40	60	100	**3**
	Professional Elective - II	**PE**	3	3	0	0	**3**	40	60	100	**3**
	Professional Elective - III	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDP201	Vibration Laboratory	**PC**	3	0	3	0	**3**	40	60	100	**2**
M19EDP202	Design Project	**PW**	3	0	6	0	**3**	40	60	100	**2**
Total Contact Hours/Week			**24**	**18**	**9**	**0**	**Total Credits**				**22**

BoS Chairman

Semester - III											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
	Open Elective I	OE	3	3	0	0	3	40	60	100	3
	Professional Elective IV	PE	3	3	0	0	3	40	60	100	3
	Professional Elective V	PE	3	3	0	0	3	40	60	100	3
M19EDP301	Project Work Phase I	PW	20	0	12	0	3	40	60	100	6
Total Contact Hours / Week			29	9	12	0	Total Credits				15

Semester - IV											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19EDP401	Project Work Phase II	PW	40	0	24	0	3	40	60	100	12
Total Contact Hours / Week			40	0	24	0	Total Credits				12

Basic Science (BS)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (ESE)	CIA	SSE	Total	
M19MAT103	Applied Mathematics for Engineers	BS	4	3	0	1	3	40	60	100	4

BoS Chairman

PROFESSIONAL CORE (PC)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19EDT101	Design of Material Handling Equipments	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT102	Computer Applications in Design	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT103	Quality Concepts in Design	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT104	Advanced Finite Element Analysis	**PC**	4	3	0	1	**3**	40	60	100	**3**
M19EDT201	Surface Engineering	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT202	Mechanical Behavior of Materials	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT203	Integrated Mechanical Design	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDT204	Vibration Analysis and Control	**PC**	3	3	0	0	**3**	40	60	100	**3**
M19EDP101	CAD Laboratory	**PC**	3	0	3	0	**3**	40	60	100	**2**
M19EDP102	Advanced Analysis and Simulation Laboratory	**PC**	3	0	3	0	**3**	40	60	100	**2**
M19EDP201	Vibration Laboratory	**PC**	3	0	6	0	**3**	40	60	100	**2**

PROFESSIONAL ELECTIVES (PE)											
SEMESTER – I											
ELECTIVE – I											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19EDE101	Optimization Techniques in Design	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDE102	Design of Pressure Vessel and Piping	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDE103	Engineering Fracture Mechanics	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDE104	Additive Manufacturing and Tooling	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDE105	Information Analytics	**PE**	3	3	0	0	**3**	40	60	100	**3**

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SEMESTER – II											
ELECTIVE – II & III											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19EDE201	Plates and Shells	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDE202	Modal Analysis of Mechanical Systems	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDE203	Advanced Metal Forming Techniques	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDE204	Tribology in Design	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDE205	Mechanisms Design and Simulation	**PE**	3	3	0	0	**3**	40	60	100	**3**
M19EDE206	Advanced Mechanics of Materials	**PE**	3	3	0	0	**3**	40	60	100	**3**

SEMESTER – III											
ELECTIVE – IV & V											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19EDE301	Advanced strength of materials	**PE**	3	3	0	0	3	40	60	100	**3**
M19EDE302	Design of Hydraulic and Pneumatic Systems	**PE**	3	3	0	0	3	40	60	100	**3**
M19EDE303	Bearing Design and Rotor Dynamics	**PE**	3	3	0	0	3	40	60	100	**3**
M19EDE304	Product Design for Sustainability	**PE**	3	3	0	0	3	40	60	100	**3**
M19EDE305	Green Manufacturing Practices	**PE**	3	3	0	0	3	40	60	100	**3**
M19EDE306	Design for Manufacture, Assembly and Environments	**PE**	3	3	0	0	3	40	60	100	**3**
M19EDE307	Biomechanics	**PE**	3	3	0	0	3	40	60	100	**3**
M19EDE308	Composite Materials and Mechanics	**PE**	3	3	0	0	3	40	60	100	**3**
M19EDE309	Design for Internet of Things	**PE**	3	3	0	0	3	40	60	100	**3**

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SEMESTER – III											
OPEN ELECTIVES (OE)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19MBO301	Product Lifecycle Management	OE	3	3	0	0	3	40	60	100	3
M19MBO302	Cost Management of Engineering Projects	OE	3	3	0	0	3	40	60	100	3
M19MBO303	Research Methodology and IPR	OE	3	3	0	0	3	40	60	100	3

PROJECT WORK COURSES (PW)											
Course Code	Course Name	Category	Instructional Hours				Assessment				Credit
			Contact Periods	T	P	TU	Hours of Exam. (SEE)	CIA	SEE	Total	
M19EDP202	Design Project	PW	3	0	6	0	3	40	60	100	2
M19EDP301	Project Work Phase I	PW	20	0	12	0	3	40	60	100	6
M19EDP401	Project Work Phase II	PW	40	0	24	0	3	40	60	100	12

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Semester - I

M.E - E.D	M19MAT103 - APPLIED MATHEMATICS FOR ENGINEERS	T	P	TU	C
		3	0	1	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.

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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	M19EDT101 – DESIGN OF MATERIAL HANDLING EQUIPMENTS	T	P	TU	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.	Understand the flow and type of movement of industrial goods.
4.	Apply general rules for the type of movement.
5.	Identify the appropriate material handling systems to suit the said requirement.

UNIT - I	MATERIALS HANDLING EQUIPMENT	5
Types, 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.		
		Total Instructional hours : 45

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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.

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M.E - E.D	M19EDT102 - COMPUTER APPLICATIONS IN DESIGN	T	P	TU	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.

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M.E - E.D	M19EDT103 - QUALITY CONCEPTS IN DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on materials selection and manufacturing processes integrated with Engineering Design.
2.	To evaluate and refine the design using computer simulations.
3.	To understand the need for component design.
4.	To understand the concept of conveyors.
5.	To calculate and evaluate design of elevators.

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 and illustrate the basic concepts of Design.
CO2	Identify the materials and integrate the manufacturing processes with Engineering Design.
CO3	Apply economic principles for a component design.
CO4	Explain the various concepts in design, quality and reliability principles in the design of an engineering product or a service.
CO5	Examine fracture rate and residual stress objects for the components.

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, Tata Mcgraw Hill, 5th Edition, 2013.

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M.E - E.D	M19EDT104 - ADVANCED FINITE ELEMENT ANALYSIS	T	P	TU	C
		3	0	1	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	FINITE ELEMENTS IN STRUCTURAL DYNAMICS APPLICATIONS	12
Dynamic equations – mass matrix – natural frequencies and modes – Longitudinal, transverse and torsional systems. Transient vibration analysis- mode super position scheme- direct integration methods - example problems		
		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.

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M.E.	M19EDP101 - CAD LABORATORY	T	P	TU	C
		0	3	0	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 I. Flange coupling II. Plummer block bearing III. Universal joint IV. Piston and connecting rod V. Knuckle joint
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

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

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M.E.	M23EDP102 - ADVANCED ANALYSIS AND SIMULATION LABORATORY	T	P	TU	C
		0	3	0	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.

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5.	Thermal stress and heat transfer analysis of plates.
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.

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Semester - II

M.E - E.D	M19EDT201 - SURFACE ENGINEERING	T	P	TU	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.

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M.E - E.D	M19EDT202 - MECHANICAL BEHAVIOR OF MATERIALS	L	T	P	C
		3	0	0	3

Course Objectives	
1.	Impart the knowledge on mechanical behavior of materials.
2.	Acquire knowledge in various classes of materials and their applications.
3.	Import knowledge on various surface modification techniques.
4.	Analyze the type of fracture in materials.
5.	Impart the knowledge of creep and fatigue in materials.

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	Explain the mechanical behavior of metallic systems and its importance.
CO2	Demonstrate on engineering alloys and nonmetallic materials and their selection.
CO3	Explain the different types of surface modifications of materials.
CO4	Analyze the type of fracture in materials.
CO5	Categorize the behavior of creep and fatigue in materials.

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.

BoS Chairman

M.E - E.D	M19EDT203 - INTEGRATED MECHANICAL DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the principals involved in evaluating the shape and dimensions of a component to satisfy functional and strength requirements.
2.	To learn to use standard practices and standard data.
3.	To gain knowledge on the principles and procedure for the design of Mechanical power Transmission components.
4.	To understand the standard procedure available for Design of Transmission of Mechanical elements.
5.	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.

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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

Course Outcomes : Students will be able to	
CO1	Outline the usage of standards and tolerances in design.
CO2	Solve problems in design of shaft.
CO3	Design gears for various application.
CO4	Design the clutches.
CO5	Discuss the working of brakes for automobile, machine tools and material handling equipment's and solve problems.

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.

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M.E - E.D	M19EDT204 - VIBRATION ANALYSIS AND CONTROL	T	P	TU	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
Bucket elevators : design - loading and bucket arrangements - Cage elevators - shaft way, guides, counter weights, hoisting machine, safety devices - Design of fork lift trucks.		
		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.

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M.E - E.D	M19EDP201 - VIBRATION LABORATORY	T	P	TU	C
		0	3	0	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.

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 moment of inertia of unknown object by oscillation.
3.	To determine the radius of gyration ‘k’ of a given compound pendulum.
4.	To determine the natural frequency of undamped torsional vibration of a single rotor shaft system.
5.	To determine the natural frequency of undamped torsional vibration of two rotor shaft system.
6.	To determine the frequency of undamped free vibration of an equivalent spring mass system.
7.	To determine the frequency of damped force vibration of a spring mass system.
8.	Balancing of rotating masses.
9.	Balancing of reciprocating masses in various speed.
10.	To determine the critical (whirling) speed of the given rotor.
	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.

BoS Chairman

M.E.	M19EDP202 - DESIGN PROJECT	T	P	TU	C
		0	6	0	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.

Syllabus
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.

BoS Chairman

Semester - III

M.E.	M19EDP301 – Project Work Phase I	T	P	TU	C
		0	12	0	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.

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Semester - IV

M.E.	M19EDP401 – PROJECT WORK – PHASE II	T	P	TU	C
		0	24	0	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 Outcomes : At the end of the course student will

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.

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Professional Elective

M.E - E.D	M19EDE101 – OPTIMIZATION TECHNIQUES IN DESIGN	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To impart knowledge on various categories of existing engineering problems and solutions to such problems through different optimization techniques and approaches.
2.	Understanding the Concept of optimization and classification of optimization problems.
3.	Study the Queuing Model, poison and exponential distributions.
4.	Understand the maximization and minimization of convex functions.
5.	To study equality constraints, inequality constraints.

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	Summarize clearly a problem, identify its parts and analyze the individual functions.
CO2	Identify study for solving an optimization problem.
CO3	Apply a mathematical translation of the verbal formulation of an optimization problem.
CO4	Construct design algorithms, the repetitive use of which will lead reliably to finding an approximate solution.
CO5	Develop optimization techniques using algorithms.

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.

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M.E - E.D	M19EDE102 – DESIGN OF PRESSURE VESSEL AND PIPING	T	P	TU	C
		3	0	0	3

	Course Objectives
1.	To understand about pressure vessels and their applications.
2.	To Develop the pressure vessel that suitable for industrial purposes.
3.	To understand the different types of vessels and their applications.
4.	To understand the various design considerations.
5.	To understand about piping design and their types.

UNIT - I	STRESSES IN PRESSURE VESSELS	9

General theory of membrane stresses in vessel under internal pressure and its application to shells (cylindrical, conical and spherical) and end closures - Bending of circular plates and determination of stresses in simply supported and clamped circular plate - Thermal stresses, Stress concentration in plate having circular hole due to bi-axial loading, Excessive elastic deformation, Plastic instability, Brittle rupture and creep - Theory of reinforced opening and reinforcement limits

UNIT - II	DESIGN OF VESSELS USING CODES	9

Introduction to ASME codes for pressure vessel design - Pressure vessel and related components design using ASME codes - Supports for short vertical vessels, Stress concentration at a variable thickness transition section in a cylindrical vessel - Design of nozzles.

UNIT - III	SUPPORTS FOR VERTICAL & HORIZONTAL VESSELS	9

Design of base plate and support lugs - Types of anchor bolt, its material and allowable stresses - Design of saddle supports.

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UNIT - IV	OTHER DESIGN CONSIDERATIONS	9
Buckling phenomenon - Elastic Buckling of circular ring and cylinders under external pressure - Collapse of thick walled cylinders or tubes under external pressure - Effect of supports on Elastic Buckling of Cylinders - Design of circumferential stiffeners, and Buckling under combined External pressure and Axial loading -Fatigue, shock, high pressure, high temperature, irradiation, corrosion, and other hostile environments; High strength, lightweight pressure vessels - Vessels resistant to external high pressures found in undersea exploration, offshore drilling, and mineral mining		

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 stresses in pressure vessels.
CO2	Develop pressure vessels using codes.
CO3	Develop support members of pressure vessels.
CO4	Apply various design considerations for pressure vessels.
CO5	Develop of pressurized fluid piping.

Reference Books	
1.	John Kihiu, George Rading, Stephan Mutuli, “Boiler, Piping and Pressure Vessel Cross Bore Design Stresses”, 2011.
2.	Harvey J.F., “Pressure Vessel Design”, CBS, publication, 2010.

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M.E - E.D	M19EDE103 – ENGINEERING FRACTURE MECHANICS	T	P	TU	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.

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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.

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M.E - E.D	M19EDE104 – ADDITIVE MANUFACTURING AND TOOLING	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To educate students with fundamental and advanced knowledge in the field of Additive manufacturing technology and the associated Aerospace, Architecture, Art, Medical and industrial applications.
2.	Understand the various software tools, processes and techniques that enable advanced/additive manufacturing and personal fabrication.
3.	Learn how to create physical objects that satisfy product development/prototyping requirements, using advanced/additive manufacturing devices and processes.
4.	Understand the latest trends and business opportunities in AM, distributed manufacturing and mass customization.
5.	Learn what Advanced/Additive manufacturing (AM) is and understand why it has become one of the most important technology trends in decades for product development and innovation.

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.

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M.E - E.D	M19EDE105 – INFORMATION ANALYTICS	T	P	TU	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.

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M.E - E.D	M19EDE201 – PLATES AND SHELLS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the behavior of the plates and shells with different geometry under various types of loads.
2.	To impart knowledge on application of governing equation to bending of plates of various shapes.
3.	To understand the design procedure of plates and shell elements in practical applications.
4.	To provide a knowledge of the fundamentals of theory of shells and folded plates.
5.	To analyze and design thin shell structures including domes, hyperbolic, parabolic, elliptic and cylindrical shells.

UNIT - I	GENERAL INTRODUCTION	8

Review of equations of elasticity- kinematics, compatibility equations, stress measures- equations of motions- constitutive relations- transformation of stresses, strains and stiffness-energy principles and variational methods in elasticity- virtual work-external and internal virtual work variational operator-functionals - Euler Lagrange equations- energy principles- Hamilton's principle- principle of minimum total potential- applications.

UNIT - II	CLASSICAL THEORY OF PLATES	10

Plates as structural elements- stress and moment resultants- assumptions made in the classical theory- displacement fields and strains- equations of equilibrium in Cartesian coordinates and in polar coordinates- boundary conditions – bending of rectangular plates with various boundary conditions and loading- symmetrical and asymmetrical bending of circular plates-limitations of classical theory- finite element analysis(elementary treatment only).

UNIT - III	BUCKLING ANALYSIS OF RECTANGULAR PLATES	9

Buckling of simply supported plates under compressive forces- governing equations- the Navier solution-biaxial compression of a plate - uniaxial compression of a plate- buckling of plates simply supported on two opposite edges- Levy's solution- buckling of plates with various boundary conditions- general formulation- finite element analysis(elementary treatment only).

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UNIT - IV	VIBRATION OF PLATES	9
Governing equations for natural flexural vibrations of rectangular plates- natural vibrations of plates simply supported on all edges- vibration of plates with two parallel sides simply supported- Levy's solution- vibration of plates with different boundary conditions- Rayleigh-Ritz method- Natural vibration of plates with general boundary conditions- transient analysis of rectangular plates- finite element analysis(elementary treatment only)		

UNIT - V	ANALYSIS OF THIN ELASTIC SHELLS OF REVOLUTION	9
Classification of shell surfaces- geometric properties of shells of revolution- general strain displacement relations for shells of revolution- stress resultants- equations of motion of thin shells analytical solution for thin cylindrical shells- membrane theory- flexure under axisymmetric loads shells with double curvature- geometric considerations- equations of equilibrium- bending of spherical shells- vibration of cylindrical shells- finite element analysis(elementary treatment only; discussion of various elements used and their capabilities- not for examination)		
	Total Instructional hours : 45	

Course Outcomes : Students will be able to	
CO1	Choose Different types of plates based on bending properties.
CO2	Select the Application of governing equation to bending of plates of various shapes.
CO3	Apply Vibration analysis of plates.
CO4	Apply Numerical methods for plate analysis.
CO5	Develop Theory of shells.

Text Books	
1.	K. Baskar and T.K. Varadan, "Plates - Theories and Applications", Ane Books Pvt. Ltd., New Delhi, 2013.

Reference Books	
1.	Hui-ShenShen., "Functionally Graded Materials: Nonlinear Analysis of Plates and Shells", 1st Edition, Kindle Edition 2013
2.	Dimitri E. Beskos., "Boundary Element Analysis of Plates and Shells (Springer Series in Computational Mechanics)", 2012.
3.	Erasmo Carrer., "Plates and Shells for Smart Structures: Classical and Advanced Theories for Modeling and Analysis", 1st Edition 2011.

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M.E - E.D	M19EDE202 – MODAL ANALYSIS OF MECHANICAL SYSTEMS	T	P	TU	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	6

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	12

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	11

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	10

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	6
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.

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M.E - E.D	M19EDE203 – ADVANCED METAL FORMING TECHNIQUES	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To study the concepts of latest metal forming techniques and their applications in metal forming industry.
2.	To study the thermo mechanical regimes and its requirements of metal forming.
3.	To study the special forming process.
4.	To study the recent advances of bulk forming process.
5.	To study and apply electromagnetic farming.

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.

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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.	Ronak khandelwal “Performance Analysis of Electromagnetic Forming Process”, 2015.
2.	H.S. Shan, “Manufacturing Processes: Casting, Forming and Welding”, 2017.

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M.E - E.D	M19EDE204 – TRIBOLOGY IN DESIGN	T	P	TU	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.- Orbital forging – Isothermal forging – Hot and cold isostatic pressing – High speed extrusion – Rubber pad forming – Fine blanking – LASER beam forming.

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UNIT - V	ELECTROMAGNETIC FORMING AND ITS APPLICATIONS	9
Surface Topography measurements – Electron microscope and friction and wear measurements – Laser method – instrumentation - International standards – bearing performance measurement – 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.

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M.E - E.D	M19EDE205 – MECHANISMS DESIGN AND SIMULATION	T	P	TU	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.

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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. Sando R., “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.	Amitabha Ghosh 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.

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M.E - E.D	M19EDE206 – ADVANCED MECHANICS OF MATERIALS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To know the fundamentals of mechanics of materials under various loading conditions.
2.	To provide a thorough understanding of advanced topics concerning the response of materials and structural elements to applied forces of deformation.
3.	To give a firm foundation to advanced design topics while providing the foundations to finite element solutions to more complex problems.
4.	Understand the fundamental concepts of stress and strain and the relationship between both through the strain-stress equations in order to solve problems for simple tri-dimensional elastic solids.
5.	Understand the pure and non-uniform bending of beams and other simple structures.

UNIT - I	ELASTICITY	9

Stress-Strain relations and general equations of elasticity in Cartesian, Polar and curvilinear 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. Energy methods.

UNIT - II	SHEAR CENTER AND UNSYMMETRICAL BENDING	10

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

UNIT - III	STRESSES IN FLAT PLATES AND CURVED MEMBERS	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. Solution of rectangular plates – pure bending of plates – deflection – uniformly distributed load – various end conditions.

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 IN ROTATING MEMBERS 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	Demonstrate the ability to deconstruct complex problems to produce effective outcomes.
CO2	Demonstrate the independent judgment required to interpret the results of these solutions.
CO3	Explain the selection, design and stress analysis of composite materials.
CO4	Analyze the stresses in simple structures as used in the aerospace industry.
CO5	Develop the theory, concepts, principles and governing equations of solid mechanics.

Text Books	
1.	Allan F. Bower, “Applied Mechanics of Solids”, CRC press – Special Indian Edition -2012,
2.	Arthur P. Boresi, Richard J. Schmidt, “Advanced mechanics of materials”, John Wiley, 2011.

Reference Books	
1.	G.H. Ryder, “Strength of Materials”, Macmillan, India Ltd, 2011.
2.	K. Baskar and T.K. Varadan, “Theory of Isotropic/Orthotropic Elasticity”, Ane Books Pvt. Ltd., New Delhi, 2009
3.	Robert D. Cook, Warren C. Young, "Advanced Mechanics of Materials", Mc- millan pub. Co.,2005.
4.	Uicker.J.J, Pennock.G.R, Shighley.J.E, “Theory of machines and mechanisms”, Oxford university Press, 2005.

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M.E	M19EDE301 – ADVANCED STRENGTH OF MATERIALS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	Understand and explain the concept of stress – strain relationship.
2.	Understand the general equation of elasticity.
3.	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	7

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	12

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.

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

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Course Outcomes : Students will be able to	
CO1	Explain the concept of stress – strain relationship and general equation of elasticity.
CO2	Analyze the mechanism of shear flow and stresses and deflection in unsymmetrical loading condition.
CO3	Design shafts to transmit required power and to design the rotary sections in engineering application.
CO4	Analyze the problems in torsion of non-circular cross sections.
CO5	Analyze the problems in contact stresses.

Text 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.	Seely and Smith, “Advanced Mechanics of Materials”, John Wiley International Edn. 1952.

Reference Books	
1.	Rimoahwnko, “Strength of Materials”, Van Nostrand.
2.	Wang, “Applied Elasticity”, McGraw Hill.
3.	Cas, “Strength of Materials”, Edward Arnold, London 1957. Robert D. Cook, Warren C. Young, “Advanced Mechanics of Materials”, Mc-Millan pub. Co., 1985.

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M.E	M19EDE302 – DESIGN OF HYDRAULIC AND PNEUMATIC SYSTEMS	T	P	TU	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	7

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

UNIT - II	CONTROL AND REGULATION ELEMENTS	10

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

UNIT - III	HYDRAULIC CIRCUITS	8

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

UNIT - IV	PNEUMATIC SYSTEMS AND CIRCUITS	10

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	TIME SERIES FORECASTING AND DESIGN OF EXPERIMENTS	10
Pneumatic equipments- selection of components - design calculations – application -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.
CO2	Explain the working of control components of hydraulics.
CO3	Draw hydraulic circuits for various applications.
CO4	Explain the fundamentals of pneumatics and construct pneumatic circuits.
CO5	Construct special hydro 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.	Bolton. W., “Pneumatic and Hydraulic Systems “, Butterworth – Heinemann, 1997.
5.	Dudleyt, A. Pease and John J. Pippenger, “Basic Fluid Power”, Prentice Hall,1987.
6.	www.pneumatics .com
7.	www.fluidpower.com

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M.E	M19EDE303 – BEARING DESIGN AND ROTOR DYNAMICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To know about different types of bearings available for machine design and their operating principles.
2.	To design hydrodynamic for given specifications and analyze the bearings for their performance.
3.	To understand hydrostatic bearing for given specifications and analyze the bearings for their performance.
4.	To design rolling bearing for given specifications and analyze the bearings for their performance.
5.	To understand the bearing behavior under dynamic conditions.

UNIT - I	CLASSIFICATION AND SELECTION OF BEARINGS	6

Selection criteria-Dry and Boundary Lubrication Bearings-Hydrodynamic and Hydrostatic bearings Electro Magnetic Bearings-Dry Bearings-Rolling Element bearings- Bearings for Precision. Applications-Foil Bearings-Special bearings- Selection of plain Bearing materials –Metallic and Nonmetallic bearings.

UNIT - II	DESIGN OF FLUID FILM BEARINGS	10

Design and performance analysis of Thrust and Journal bearings – Full, partial, fixed and pivoted journal bearings design procedure-Minimum film thickness – lubricant flow and delivery – power loss, Heat and temperature distribution calculations- Design based on Charts & Tables and Experimental curves-Design of Foil bearings-Air Bearings- Design of Hydrostatic bearings-Thrust and Journal bearings-Stiffness consideration - flow regulators and pump design.

UNIT - III	SELECTION AND DESIGN OF ROLLING BEARINGS	10

Contact Stresses in roller bearings - Centrifugal Stresses - Elasto Hydro dynamic lubrication – Fatigue life Calculations – Bearing Operation Temperature – Lubrication - Selection of lubricants-Internal clearance – Shaft and housing fit- -Mounting arrangements Materials for rolling bearings-Manufacturing methods-Ceramic Bearings-Rolling bearing cages bearing seals selection.

UNIT - IV	DYNAMICS OF HYDRODYNAMIC BEARINGS	10

Hydrodynamic Lubrication equation for dynamic loadings-Squeeze film effects in journal bearings and thrust bearings -Rotating loads, alternating and impulse loads in journal bearings – Journal centre Trajectory- Analysis of short bearings under dynamic conditions- Finite difference solution for dynamic conditions.

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UNIT - V	TIME SERIES FORECASTING AND DESIGN OF EXPERIMENTS	9
Rotor vibration and Rotor critical speeds- support stiffness on critical speeds- Stiffness and damping coefficients of journal bearings-computation and measurements of journal bearing coefficients - Mechanics of Hydro dynamic Instability- Half frequency whirl and Resonance whip-Design configurations of stable journal bearings.		
		Total Instructional hours : 45

Course Outcomes : Students will be able to	
CO1	Acquisition of knowledge in the analysis of all types of bearings.
CO2	Ability to make specifications of all types of bearings.
CO3	Skill for conducting dynamic / vibration analysis and troubleshooting of bearings.
CO4	Analysis of short bearings under dynamic conditions.
CO5	Design configurations of stable journal bearings.

Reference Books	
1.	Gwidon Stachowiak and Andrew Batchelor, “Engineering Tribology”, 4th Edition, Butterworth-Heinemann, 2013.
2.	S.K. Basu, S.N. Sengupta & B.B. Ahuja,” Fundamentals of Tribology”, Prentice – Hall of India Pvt Ltd, New Delhi, 2005.
3.	Neale, M.J. “Tribology Hand Book”, Butterworth Heinemann, United Kingdom 2001.
4.	Halling, J. (Editor) – “Principles of Tribology”, McMillian,1984.
5.	Williams J.A. “Engineering Tribology”, Oxford Univ. Press, 1994.

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M.E	M19EDE304 – PRODUCT DESIGN FOR SUSTAINABILITY	T	P	TU	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 input-output. 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.

UNIT - IV	STAINABLE 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.

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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	Understand the concept of sustainability in terms of design, construction and development.
CO2	Build knowledge in engineering design tools and life cycle assessment.
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, Department of Mechanical Engineering-Engineering Mechanics, Michigan Technological University, 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..

BoS Chairman

M.E	M19EDE305 – GREEN MANUFACTURING PRACTICES	T	P	TU	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 importance of fire safety.
5.	To learn the radiation fundamentals.

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 equation-the 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

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UNIT - IV	FIRE SAFETY	9
Basic Elements, Causes, Industrial Fires, Explosions, Effects on Environmental, Property & Human Loss, Prevention technique, Building Design, Fire Protection System, contingency plan, Emergency preparedness, Evacuation.		

UNIT - V	SAFETY RADIATION PROTECTION	9
Radiation fundamentals-Types of radiation Ionizing and Non-Ionizing radiation, their uses and biological effects. Radioactive waste disposal radioactive soil, water and air and their fate. Treatment and disposal Liquid and solid Radioactive wastes.		
		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	Build state of the art fire safety buildings.
CO5	Apply of safety tools to prevent the Industrial and Commercial Building from radiation.

Text Books	
1.	Dornfield David, “Green Manufacturing”, Springer, 2012.
2.	Davim J. Pauls, “Green Manufacturing Processes and Systems”, Springer, 2013.

Reference Books	
1.	Cairncrss and Francis, “Costing the Earth”, Harvard Business School Press, 2009.
2.	Gradel.T.E. and B.R. Allenby, “Industrial Ecology”, Prentice Hall, 2010.
3.	“World Commission on Environment and Development (WCED)”, Our Common Future, Oxford University Press, 2005.

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M.E	M19EDE306 – DESIGN FOR MANUFACTURE ASSEMBLY AND ENVIRONMENTS	T	P	TU	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.

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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, “Design for Assembly Automation and Product Design”, New York, Marcel Dekker, 1980.
2.	Bralla, “Design for Manufacture 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 the Environment”, McGraw Hill., 1996.

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M.E	M19EDE307 – BIOMECHANICS	T	P	TU	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

Principles of Mechanics, Vector mechanics, Mechanics of motion - Newton's laws of motion, Kinetics, Kinematics of motion, Fluid mechanics – Euler equations and Navier Stoke's equations, Visco elasticity, Constitutive equations, Stress transformations, Strain energy function.

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.

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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”, ISBN: 978-1-119 – 99923 - 2, 2012.
2. Duane Knudson, “Fundamentals of Biomechanics”, Second Edition, Springer Science Business Media, 2007
3. Jay D. Humphrey, Sherry De Lange, “An Introduction to Biomechanics: Solids and Fluids, Analysis and Design”, Springer Science Business Media, 2004.
4. Shrawan Kumar, “Biomechanics in Ergonomics”, Second Edition, CRC Press 2007.
5. Y.C. Fung, “Bio-Mechanics - Mechanical Properties of Tissues”, Springer-Verlag, 1998.

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M.E - E.D	M19EDE308 – COMPOSITE MATERIALS AND MECHANICS	T	P	TU	C
		3	0	0	3

Course Objectives	
1.	To understand the fundamentals of composite material strength and its mechanical behavior.
2.	Understanding the analysis of fiber reinforced Laminate design for different combinations of plies with different orientations of the fiber.
3.	Study of Thermo-mechanical behavior and residual stresses in Laminates during processing.
4.	Implementation of Classical Laminate Theory (CLT) to study and analysis for residual stresses in an isotropic layered structure such as electronic chips.
5.	To understand the basic knowledge about thermal analysis of composites.

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, Fiber-reinforced 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.

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.

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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	Understand and discuss the basic principle behind the various fabrication techniques in Composites.
CO3	Develop models the mechanical behavior of Composites in both micro and macro level.
CO4	Understand and explain the specifications of mechanical behavior of layered composites compared to isotropic materials.
CO5	Determine stresses and strains in composites.

Reference Books	
1.	Chung, Deborah D.L., "Composite Materials: Science and Applications", Ane Books Pvt. Ltd./ Springer, New Delhi, 1st Indian Reprint, 2009.
2.	Madhujit Mukhopadhyay, "Mechanics of Composite Materials and Structures", University Press (India) Pvt. Ltd., Hyderabad, 2004 (Reprinted 2008).
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", Maneel Dekker . Inc, 1993.
5.	Halpin, J.C., "Primer on Composite Materials, Analysis", Techomic Publishing Co., 1984.

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M.E	M19EDE309 – DESIGN FOR INTERNET OF THINGS	T	P	TU	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.

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Open Elective

M.E	M19MBO301 – PRODUCT LIFECYCLE MANAGEMENT	T	P	TU	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 understand integration of PLM/PDM with other 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	BASICS ON CUSTOMISATION/INTEGRATION OF PDM/PLM SOFTWARE	9
PLM Customization, use of EAI technology (Middleware), Integration with legacy data base, CAD, SLM and ERP		
		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	Relate PLM/PDM with other applications.

Text 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).

Reference Books	
1.	Ivica Crnkovic, Ulf Asklund and Annita Persson Dahlqvist, “Implementing and Integrating Product Data Management and Software Configuration Management”, Artech House Publishers, 2003.
2.	John Stark, “Global Product: Strategy, Product Lifecycle Management and the Billion Customer Question”, Springer Publisher, 2007.

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M.E	M19MBO302 – COST MANAGEMENT OF ENGINEERING PROJECTS	T	P	TU	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 various manufacturing processes.

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.

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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	To apply project management principles in business situations to optimize time and resource utilization.
CO4	To learn the principles of micro economics and cost estimation.
CO5	To apply these principles to appreciate the functioning of product and input market as well as the economy.

Text 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.

Reference Books	
1.	T.R. Banga and S.C. Sharma, “Mechanical Estimating and Costing”, Khanna Publishers, 1988.
2.	V.L. Mote, Samuel Paul and G.S.Gupta, “Managerial Economics – Concepts and Cases”, TMH, 40th reprint 2007.

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M.E - E.D	M19MBO303 – RESEARCH METHODOLOGY AND IPR	T	P	TU	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	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.

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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.

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