MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

(Autonomous Institution – UGC, Govt. of India)

Sponsored by CMR Educational Society

(Affiliated to JNTU, Hyderabad, Approved by AICTE - Accredited by NBA & NAAC – 'A' Grade - ISO 9001:2008 Certified)
Maisammaguda, Dhulapally (Post Via Hakimpet), Secunderabad – 500100, Telangana State, India.
Contact Number: 040-23792146/64634237, E-Mail ID: mrcet2004@gmail.com, website: www.mrcet.ac.in

MASTER OF TECHNOLOGY
MACHINE DESIGN

DEPARTMENT OF
MECHANICAL ENGINEERING

ACADEMIC REGULATIONS
COURSE STRUCTURE AND SYLLABUS
(Batches admitted from the academic year 2015 - 2016)

Note: The regulations hereunder are subjected to amendments as may be made by the Academic Council of the College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates (including those already pursuing the program) as may be decided by the Academic Council.

PRELIMINARY DEFINITIONS AND NOMENCLATURES

*"Autonomous Institution /College" means an institution/college designated as autonomous institute / college by University Grants Commission (UGC), as per the UGC Autonomous College Statutes.

*"Academic Autonomy" means freedom to a College in all aspects of conducting its academic programs, granted by the University for promoting excellence.

*"Commission" means University Grants Commission.

*"AICTE" means All India Council for Technical Education.

*"University" means Jawaharlal Nehru Technological University, Hyderabad.

*"College" means Malla Reddy College of Engineering & Technology, Secunderabad unless indicated otherwise by the context.

*"Program" means:

Master of Technology (M.Tech) degree program

PG Degree Program: M.Tech

*"Branch" means specialization in a program like M.Tech degree program in Mechanical Engineering , M.Tech degree program in Aeronautical Engineering etc.

*"Course" or "Subject" means a theory or practical subject, identified by its course – number and course-title, which is normally studied in a semester.

*T–Tutorial, P–Practical, D–Drawing, L-Theory, C-Credits

FOREWORD

The autonomy is conferred on Malla Reddy College of Engineering & Technology (MRCET) by UGC based on its performance as well as future commitment and competency to impart quality education. It is a mark of its ability to function independently in accordance with the set norms of the monitoring bodies like UGC and AICTE. It reflects the confidence of the UGC in the autonomous institution to uphold and maintain standards it expects to deliver on its own behalf and thus awards degrees on behalf of the college. Thus, an autonomous institution is given the freedom to have its own curriculum, examination system and monitoring mechanism, independent of the affiliating University but under its observance.

Malla Reddy College of Engineering & Technology (MRCET) is proud to win the credence of all the above bodies monitoring the quality in education and has gladly accepted the responsibility of sustaining, and also improving upon the values and beliefs for which it has been striving for more than a decade in reaching its present standing in the arena of contemporary technical education. As a follow up, statutory bodies like Academic Council and Boards of Studies are constituted with the guidance of the Governing Body of the College and recommendations of the JNTU Hyderabad to frame the regulations, course structure and syllabi under autonomous status.

The autonomous regulations, course structure and syllabi have been prepared after prolonged and detailed interaction with several experts drawn from academics, industry and research, in accordance with the vision and mission of the college which reflects the mindset of the institution in order to produce quality engineering graduates to the society.

All the faculty, parents and students are requested to go through all the rules and regulations carefully. Any clarifications, if needed, are to be sought at appropriate time and with principal of the college, without presumptions, to avoid unwanted subsequent inconveniences and embarrassments. The Cooperation of all the stake holders is sought for the successful implementation of the autonomous system in the larger interests of the institution and brighter prospects of engineering graduates.

"A thought beyond the horizons of success committed for educational excellence"

PRINCIPAL

MALLA REDDY COLLEGE OF ENGINEERING & TECHNOLOGY

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VISION

- To become a model institution in the fields of Engineering Technology and Management.
- To have a perfect synchronization of the ideologies of MRCET with challenging demands of International Pioneering Organizations

MISSION

- To establish a pedestal for the integral innovation, team spirit, originality and competence in the students, expose them to face the global challenges and become pioneers of Indian vision of modern society

QUALITY POLICY

- To implement best practices in Teaching and Learning process for both UG and PG courses meticulously.
- To provide state of art infrastructure and expertise to impart the quality education.
- To groom the students to become intellectually creative and professionally competitive.
- To channelize the activities and tune them in heights of commitment and sincerity, the requisites to claim the never ending ladder of SUCCESS year after year.

For more information: www.mrcet.ac.in

ACADEMIC REGULATIONS R-15 FOR M. TECH. (REGULAR) DEGREE COURSE

Academic Regulations of R-15 are applicable for the students of M. Tech. (Regular) Course from the Academic Year 2015-16 and onwards. The M.Tech Degree of Malla Reddy College of Engineering & Technology (MRCET), Secunderabad shall be conferred on candidates who are admitted to the program and who fulfill all the requirements for the award of the Degree.

1.0 ELIGIBILITY FOR ADMISSIONS

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

Admissions shall be made on the basis of merit/rank obtained by the candidates at the qualifying Entrance Test conducted by the University (or) State Government (or) on the basis of any other order of merit as approved by the University, subject to norms as laid down by the State Govt. from time to time.

2.0 AWARD OF M. TECH. DEGREE

2.1. A student shall be declared eligible for the award of the M. Tech. Degree, if he pursues a course of study in not less than two and not more than four academic years.
2.2. A student, who fails to fulfill all the academic requirements for the award of the degree within four academic years from the year of his admission, shall forfeit his seat in M. Tech. course.
2.3. The student shall register for all 88 credits and secure all the 88 credits.
2.4. The minimum instruction days in each semester are 90.

3.0 A. COURSE OF STUDY

The following specializations are offered at present for the M. Tech. course of study.

1. Aerospace Engineering
2. Computer Science and Engineering
3. Machine Design
4. System and Signal Processing
5. VLSI and Embedded Systems
6. Thermal Engineering

and any other course as approved by the MRCET from time to time.

3.0 B. Departments offering M. Tech. Programmes with specializations are noted below:

Aeronautical Engineering	Aerospace Engineering
Computer Science Engineering	Computer Science Engineering
Electronics & Communication Engineering	System & Signal Processing
Electronics & Communication Engineering	VLSI and Embedded Systems
Mechanical Engineering	Machine Design
Mechanical Engineering	Thermal Engineering

4.0 ATTENDANCE

The programs are offered on a unit basis with each subject being considered a unit.

4.1 A student shall be eligible to write University examinations if he acquires a minimum of 75% of attendance in aggregate of all the subjects.
4.2 Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester shall be granted by the College Academic Committee.
4.3 Shortage of Attendance below 65% in aggregate shall not be condoned.
4.4 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of that class and their registration shall stand cancelled.
4.5 A prescribed fee as determined by the examination branch shall be payable towards condonation of shortage of attendance.
4.6 A student shall not be promoted to the next semester unless he satisfies the attendance requirement of the present semester, as applicable. They may seek readmission into that semester when offered next. If any candidate fulfills the attendance requirement in the present semester, he shall not be eligible for readmission into the same class.
4.7 In order to qualify for the award of the M. Tech. Degree, the candidate shall complete all the academic requirements of the subjects, as per the course structure.
4.8 A student shall not be promoted to the next semester unless he satisfies the minimum academic requirements of the previous semester.

5.0 EVALUATION

The performance of the candidate in each semester shall be evaluated subject-wise, with a maximum of 100 marks for theory and 100 marks for practicals, on the basis of Internal Evaluation and End Semester Examination.
For the theory subjects 75 marks shall be awarded based on the performance in the End Semester Examination and 25 marks shall be awarded based on the Internal Examination Evaluation. The internal evaluation consists of two mid-term examination of 25 marks each covering descriptive paper which consists 5 questions consisting of two parts each (a) and (b), out of which the student has to answer either (a) or (b), not both. Each question carries 5 marks for a total duration of 2 hours. The total marks secured by the student in each mid-term examination are evaluated for 25 marks, and the average of the two mid-term examinations shall be taken as the final marks secured by each candidate.
However, any student scoring internal marks less than 40% will be given a chance to write the internal exam once again after he/she re-registering for the concerned subject and paying stipulated fees as per the norms.

5.1 The end semesters examination will be conducted for 75 marks with 5 questions consisting of two questions each (a) and (b), out of which the student has to answer

either (a) or (b), not both and each question carries 15 marks.

5.2 For practical subjects, 75 marks shall be awarded based on the performance in the End Semester Examinations and 25 marks shall be awarded based on the day-to-day performance as Internal Marks.

5.3 There shall be two seminar presentations during I year I semester and II semester respectively. For seminar, a student under the supervision of a faculty member, shall collect the literature on a topic and critically review the literature and submit it to the department in a report form and shall make an oral presentation before the Departmental Academic Committee consisting of Head of the Department, Supervisor and two other senior faculty members of the department. For each Seminar there will be only internal evaluation of 50 marks. A candidate has to secure a minimum of 50% of marks to be declared successful.

5.4 A candidate shall be deemed to have secured the minimum academic requirement in a subject if he secures a minimum of 40% of marks in the End semester Examination and a minimum aggregate of 50% of the total marks in the End Semester Examination and Internal Examination taken together.

5.5 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.4) he has to reappear for the End semester Examination in that subject.

5.6 A candidate shall be given one chance to re-register for each subject provided the internal marks secured by a candidate are less than 50% and so has failed in the end examination. In such a case, the candidate must re-register for the subject(s) and secure the required minimum attendance. The candidate's attendance in the re-registered subject(s) shall be calculated separately to decide upon his eligibility for writing the end examination in those subject(s). In the event of the student taking another chance, his internal marks and end examination marks obtained in the previous attempt stand cancelled.

5.7 In case the candidate secures less than the required attendance in any subject, he shall not be permitted to write the End Examination in that subject. He shall re-register the subject when next offered.

5.8 Laboratory examination for M. Tech. courses must be conducted with two Examiners, one of them being the Laboratory Class Teacher and the second examiner shall be another Laboratory Teacher.

6.0 EVALUATION OF PROJECT/DISSERTATION WORK

Every candidate shall be required to submit a thesis or dissertation on a topic approved by the Project Review Committee.

6.1 A Project Review Committee (PRC) shall be constituted with Principal as Chairperson, Heads of all the Departments offering the M. Tech. programs and two other senior faculty members.

6.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the subjects, both theory and practical.

6.3 After satisfying 6.2, a candidate has to submit, in consultation with his project supervisor, the title, objective and plan of action of his project work to the Departmental Academic Committee for approval. Only after obtaining the

approval of the Departmental Academic Committee can the student initiate the Project work.

6.4 If a candidate wishes to change his supervisor or topic of the project, he can do so with the approval of the Departmental Academic Committee. However, the Departmental Academic Committee shall examine whether or not the change of topic/supervisor leads to a major change of his initial plans of project proposal. If yes, his date of registration for the project work starts from the date of change of Supervisor or topic as the case may be.

6.5 A candidate shall submit his status report in a bound-form in two stages at least with a gap of 3 months between them.

6.6 The work on the project shall be initiated at the beginning of the II year and the duration of the project is two semesters. A candidate is permitted to submit Project Thesis only after successful completion of theory and practical course with the approval of PRC not earlier than 40 weeks from the date of registration of the project work. For the approval of PRC the candidate shall submit the draft copy of thesis to the Principal through Head of the Department and make an oral presentation before the PRC.

6.7 Three copies of the Project Thesis certified by the supervisor shall be submitted to the College/School/Institute.

6.8 The thesis shall be adjudicated by one examiner selected by the University. For this, the Principal of the College shall submit a panel of 5 examiners, eminent in that field, with the help of the guide concerned and head of the department.

6.9 If the report of the examiner is not favorable, the candidate shall revise and resubmit the Thesis, in the time frame as decided by the PRC. If the report of the examiner is unfavorable again, the thesis shall be summarily rejected.

6.10 If the report of the examiner is favorable, Viva-Voce examination shall be conducted by a board consisting of the Supervisor, Head of the Department and the examiner who adjudicated the Thesis. The Board shall jointly report the candidate's work as one of the following:

A. Excellent
B. Good
C. Satisfactory
D. Unsatisfactory

The Head of the Department shall coordinate and make arrangements for the conduct of Viva- Voce examination.

If the report of the Viva-Voce is unsatisfactory, the candidate shall retake the Viva-Voce examination only after three months. If he fails to get a satisfactory report at the second Viva- Voce examination, he will not be eligible for the award of the degree.

7.0 AWARD OF DEGREE AND CLASS

In assessing the performance of the students in examinations, the usual approach is to award marks based on the examinations conducted at various stages (sessional, mid-term, end-semester etc.,) in a semester. As per UGC Autonomous guidelines, the following system

is implemented in awarding the grades and CGPA under the Credit Based Semester System (CBCS).

Letter Grades and Grade Points:

The UGC recommends a 10-point grading system with the following letter grades as given below:

Grades	Points	Marks secured (%)
O (Outstanding)	10	≥ 85
A+(Excellent)	9	80 – 84
A(Very Good)	8	75 – 79
B+(Good)	7	70 – 74
B(Above Average)	6	65 – 69
C(Average)	5	60 – 64
P(Pass)	4	50 – 59
F(Fail)	0	<50
Ab(Absent)	0	-

A student obtaining Grade F shall be considered failed and will be required to reappear in the examination

Computation of SGPA and CGPA

The UGC recommends the following procedure to compute the Semester Grade Point Average (SGPA) and Cumulative Grade Point Average (CGPA):

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

SGPA (S_i) = $\Sigma(C_i \times G_i) / \Sigma C_i$

where C_i is the number of credits of the i^{th} course and G_i is the grade point scored by the student in the i^{th} course.

ii. The CGPA is also calculated in the same manner taking into account all the courses undergone by a student over all the semesters of a programme, i.e.

CGPA = $\Sigma(C_i \times S_i) / \Sigma C_i$

where S_i is the SGPA of the i^{th} semester and C_i is the total number of credits in that semester.

iii. The SGPA and CGPA shall be rounded off to 2 decimal points and reported in the transcripts.

8.0 WITHHOLDING OF RESULTS

If the student has not paid the dues, if any, to the Institute or if any case of indiscipline is pending against him, the result of the student will be withheld and he will not be allowed into the next semester. His degree will be withheld in such cases.

9.0 TRANSITORY REGULATIONS

9.1 Discontinued, detained, or failed candidates are eligible for admission to two earlier or equivalent subjects at a time as and when offered.

10. GENERAL

10.1 Wherever the words he, him, his, occur in the regulations, they include she, her, hers .

10.2 The academic regulation should be read as a whole for the purpose of any interpretation.

10.3 In case of any doubt or ambiguity in the interpretation of the above rules, the decision of the Academic Council of the College is final.

10.4 The College may change or amend the academic regulations or syllabi at any time and the changes or amendments made shall be applicable to all the students with effect from the dates notified by the Academic Council of the College/Affiliating University.

MALPRACTICES RULES
DISCIPLINARY ACTION FOR / IMPROPER CONDUCT IN EXAMINATIONS

S.No	Nature of Malpractices/Improper conduct If the candidate:	Punishment
1. (a)	Possesses or keeps accessible in examination hall, any paper, note book, programmable calculators, Cell phones, pager, palm computers or any other form of material concerned with or related to the subject of the examination (theory or practical) in which he is appearing but has not made use of (material shall include any marks on the body of the candidate which can be used as an aid in the subject of the examination)	Expulsion from the examination hall and cancellation of the performance in that subject only.
(b)	Gives assistance or guidance or receives it from any other candidate orally or by any other body language methods or communicates through cell phones with any candidate or persons in or outside the exam hall in respect of any matter.	Expulsion from the examination hall and cancellation of the performance in that subject only of all the candidates involved. In case of an outsider, he will be handed over to the police and a case is registered against him.
2.	Has copied in the examination hall from any paper, book, programmable calculators, palm computers or any other form of material relevant to the subject of the examination (theory or practical) in which the candidate is appearing.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted to appear for the remaining examinations of the subjects of that Semester. The Hall Ticket of the candidate is to be cancelled and sent to the University.
3.	Impersonates any other candidate in connection with the examination.	The candidate who has impersonated shall be expelled from examination hall. The candidate is also debarred and forfeits the seat. The performance of the original candidate who has been impersonated, shall be cancelled in all the subjects of the examination (including practicals and project work) already appeared and shall not be

		allowed to appear for examinations of the remaining subjects of that semester. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat. If the imposter is an outsider, he will be handed over to the police and a case is registered against him.
4.	Smuggles in the Answer book or additional sheet or takes out or arranges to send out the question paper during the examination or answer book or additional sheet, during or after the examination.	Expulsion from the examination hall and cancellation of performance in that subject and all the othe subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Using objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks.	Cancellation of the performance in that subject.
6.	Refuses to obey the orders of the Chief Superintendent/Assistant Superintendent / any officer on duty or misbehaves or creates disturbance of any kind in and around the examination hall or organizes a walk out or instigates others to walk out, or threatens the officer-in charge or any person on duty in or outside the examination hall of any injury to his person or to any of his relations whether by words, either spoken or written or by signs or	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester. The

	by visible representation, assaults the officer-incharge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	candidates also are debarred and forfeit their seats. In case of outsiders, they will be handed over to the police and a police case is registered against them.
7.	Leaves the exam hall taking away answer script or intentionally tears of the script or any part thereof inside or outside the examination hall.	Expulsion from the examination hall and cancellation of performance in that subject and all the other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The candidate is also debarred for two consecutive semesters from class work and all University examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
8.	Possess any lethal weapon or firearm in the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat.
9.	If student of the college, who is not a candidate for the particular examination or any person not connected with the college indulges in any malpractice or improper conduct mentioned in clause 6 to 8.	Student of the colleges expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including

		practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester. The candidate is also debarred and forfeits the seat. Person(s) who do not belong to the College will be handed over to police and, a police case will be registered against them.
10.	Comes in a drunken condition to the examination hall.	Expulsion from the examination hall and cancellation of the performance in that subject and all other subjects the candidate has already appeared including practical examinations and project work and shall not be permitted for the remaining examinations of the subjects of that semester.
11.	Copying detected on the basis of internal evidence, such as, during valuation or during special scrutiny.	Cancellation of the performance in that subject and all other subjects the candidate has appeared including practical examinations and project work of that semester examinations.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the Academic Council of the College (or) affiliating University for further action towards suitable punishment.	

Malpractices identified by squad or special invigilators will entail punishment to the candidates as per the above guidelines..

MALLA REDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

M.TECH. (MACHINE DESIGN)

I Year I Semester (3 Subjects+2 Electives+1 Open Elective+1 Labs)

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C	MAX MARKS	
						INT	EXT
1	R15D1501	Advanced Mechanical Engineering Design	4	-	3	25	75
2	R15D1502	Advanced Mechanics of Solids	4	-	3	25	75
3	R15D1503	Fatigue, Creep & Fracture Mechanics	4	-	3	25	75
4		**Elective I**	4	-	3	25	75
	R15D1504	Advanced Finite Element Analysis					
	R15D1505	Gear Engineering					
	R15D1506	Theory of Elasticity & Plasticity					
5		**Elective II**	4	-	3	25	75
	R15D1507	Advanced Mechanics of Composite Materials					
	R15D1508	Advanced Computer Aided Design					
	R15D1509	Applied Tribology					
6		**Open Elective I**	4	-	3	25	75
	R15D1510	Computational Methods in Engineering					
	R15D1511	Concurrent Engineering					
	R15D1512	Data Base Management System					
7	R15D1581	Kinematics and Dynamics Lab	-	3	2	25	75
8	R15D1582	Technical Seminar-I		3	2	100	-
Total			24	6	22	275	525

I Year II Semester (3 Subjects+2 Electives+1 Open Elective+ 1 Lab)

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C	MAX MARKS	
						INT	EXT
1	R15D1513	Advanced Mechanics of Machinery	4	-	3	25	75
2	R15D1514	Design Synthesis	4	-	3	25	75
3	R15D1515	Experimental Stress Analysis	4	-	3	25	75
4		**Elective III**	4	-	3	25	75
	R15D1516	Pressure Vessel Design					
	R15D1517	Computational Fluid Dynamics					
	R15D1518	Mechatronics					
5		**Elective IV**	4	-	3	25	75
	R15D1519	Theory of Plates and Shells					
	R15D1520	Advanced Optimization Techniques and Applications					
	R15D1521	Mechanical Vibrations					
6		**Open Elective II**	4		3	25	75
	R15D1522	Industrial Robotics					
	R15D1523	Computer Integrated Manufacturing					
	R15D1524	Signal Analysis and Condition Monitoring					
7	R15D1583	Computer Aided testing, Analysis and Modeling Lab	-	3	2	25	75
8	R15D1584	Technical Seminar-II	-	3	2	100	-
Total			24	6	22	275	525

II Year III Semester

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C	MAX.MARKS	
						INT	EXT
1	R15D1585	Project Seminar	-	3	4		
2	R15D1586	Project work			18		
Total				3	22		

II Year IV Semester

S.NO.	SUBJECT CODE	SUBJECT	L	T/P/D	C	MAX.MARKS	
						INT	EXT
1	R15D1587	Project work and Viva Voce	-	3	22		
Total				3	22		

MALLAREDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M .Tech I Year – I Sem(Machine Design)

L	T/P/D	C
4	-	3

(R15D1501) ADVANCED MECHANICAL ENGINEERING DESIGN

Objectives:

- Understanding the motion of the component and the basic geometry of the mechanisms. Understanding the process and methods of design of machines and elements.
- The kinematics of machines deals with the motion of members of the mechanisms which includes the determination of velocities and acceleration of the machine members.
- Abilities of developing equations pertaining to the design of machines.Knowledge of different materials and their properties for designing the components of machine elements.Ability to design new machines or modify existing machine according to the need.

UNIT-I

Design Philosophy: Design process, Problem formation, Introduction to product design, Various design models-Shigley model, Asimov model and Norton model, Need analysis, Strength considerations -standardization. Creativity, Creative techniques, Material selections, Notches and stress concentration, design for safety and Reliability.

UNIT-II

Product Design: Product strategies, value, planning and specification, concept generation, concept selection, concept testing.

Design for manufacturing: Forging design, Casting design, Design process for non metallic parts, Plastics, Rubber, Ceramic, Wood and Glass parts like. Material selection in machine design.

UNIT-III

Failure Theories: Static failure theories, Distortion energy theory, Maximum shear stress theory, Coulomb-Mohr's theory, Modified Mohr's theory, Fracture mechanics theory, Fatigue mechanisms, Fatigue failure models, Design for fatigue strength and life, creep: Types of stress variation, design for fluctuating stresses, design for limited cycles, multiple stress cycles, Fatigue failure theories ,cumulative fatigue damage, thermal fatigue and shock, harmful and beneficial residual stresses, Yielding and transformation.

UNIT-IV

Surface Failures: Surface geometry, mating surfaces, oil film and their effects, design values and procedures, adhesive wear, abrasive wear, corrosion wear, surface fatigue, different contacts, dynamic contact stresses, surface fatigue failures, surface fatigue strength.

UNIT-V

Economic Factors Influencing Design: Economic analysis, Break-even analysis, Human engineering considerations, Ergonomics, Design of controls, Design of displays. Value engineering, Material and process selection in value engineering, Modern approaches in design.

OUTCOMES:

After Completion of this course students will be able to

- Apply the knowledge of Mathematics, Science and Engineering for designing machine part. Propose the Engineering solutions for global progress, productivity and economic development. List the materials and variety of mechanical components available/used to produce every day goods and services.
- Identify and solve the engineering challenges regarding the human needs in daily life about machines and systems. List the processes and methods of design of machines and elements. Develop equations and relations pertaining to the design of machines Develop fundamental knowledge of the Standards used in the design of machine elements. List different materials and state their properties
- Design component, machine, workstation and systems etc. for safe working by minimizing accidents and other health hazards. List and define functionality of various parts used in Automobiles, working principles and their design which include brakes, Gears, Clutches, and Springs etc. Design new machines or modify the existing machines according to the need, also use the techniques, skills and modern engineering tools for engineering practice. Communicate effectively through written and oral skills.

TEXT BOOKS:

1 Machine Design An Integrated Approach / Robert L. Norton / Prentice-Hall New . Jersey, USA.
2 Engineering Design / George E Dieter / McGraw Hill /2008
3 Mechanical Engineering Design / J.E. Shigley and L.D. Mitchell / McGraw Hill . International Book Company, New Delhi.

REFERENCE BOOKS:

1 Fundamentals of machine elements/ Hamrock, Schmid and Jacobian/ 2nd edition . /McGraw-Hill International edition.
2 Product design and development / Karl T. Ulrich and Steven D. Eppinger / 3rd . edition/ Tata McGraw Hill.
3 Product Design and Manufacturing /A.K. Chitale and R.C. Gupta / Prentice Hall

MALLAREDDY COLLEGE OF ENGINEERING AND TECHNOLOGY

M.Tech I Year – I Sem (Machine Design)

L	T/P/D	C
4	0	3

(R15D1502) ADVANCED MECHANICS OF SOLIDS

Objectives:

- To understand the strain/displacement and Hooke's law relationships
- To solve torsion problems in bars and thin walled members
- To solve for stresses and deflections of beams under unsymmetrical loading and to locate the shear center of thin wall beams Course

UNIT-I

Shear Centre: Bending axis and shear center-shear center for axi-symmetric and un symmetrical sections.

Unsymmetrical Bending: Bending stresses in Beams subjected to Nonsymmetrical bending Deflection of straight beams due to nonsymmetrical bending.

UNIT-II

Curved Beam Theory: Winkler Bach formula for circumferential stress – Limitations – Correction factors – Radial stress in curved beams – closed ring subjected to concentrated and uniform lads- stresses in chain links.

UNIT- III

Torsion: Torsion of a cylindrical bar of Circular cross Section, Saint-Venant's semi-inverse methods, Linear elastic solution Prandtl elastic membrane (Soap-Film) Analogy, Narrow rectangular cross Section , Hallow thin wall torsion members, Multiply connected Cross section, Thin wall torsion members with restrained ends

Axi-Symmetric Problems: Rotating Discs – Flat discs, Discs of uniform thickness, Discs of Uniform Strength, Rotating Cylinders.

UNIT-IV

Theory of Plates: Introduction, Stress resultants in a flat plate Kinematics Strain-Displacement relations for plates Equilibrium equations for small displacement theory of flat plates Stress – Strain, – Temperature relation for Isotropic plates, Strain energy of a plate, Boundary conditions for plate Solution of rectangular plate problem, Solution of circular plate problem.

Beams on Elastic Foundation: General theory, Infinite Beam subjected to concentrated load, boundary conditions, Infinite beam subjected to a distributed lad segment, Semi-infinite beam with concentrated load near its end, Short Beams.

UNIT-V

Contact Stresses: Introduction, problem of determining contact stresses, Assumptions on which a solution for contact stresses is based, Expressions for principal stresses, Methods of computing contact stresses, Deflection of bodies in point contact; Stresses for two bodies in contact over narrow rectangular area (Line contact), Loads normal to area; Stresses for two bodies in line contact. Normal and Tangent to contact area.

TEXT BOOKS:

1. Advanced Mechanics of materials/Seely and Smith/ John Willey
2. Advanced Mechanics of materials / Boresi & Sidebottom/wiely international
3. Advanced strength of materials / Den Hortog J.P./Torrent

REFERENCE BOOKS:

1. Strength of materials / Sadhu singh/ Khanna Publishers
2. Mechanics of Materials / Beer & Jhonson / McGraw Hill
3. Theory of Plates & Shells / Timoshenko/ McGraw Hill/ 2nd Edition

OUTCOMES:

After Completion of this course students will be able to

- Understand and analyze stresses and strains at a point.Design straight beams, curved and asymmetrical bending of beams.
- Analyze and determine beams under unsymmetrical loading.
- Apply shear center of thin wall beams, torsion & ax symmetric problems

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(R15D1503) FATIGUE, CREEP AND FRACTURE MECHANICS

Objectives:

- Provide an understanding of the mechanics and micro-mechanisms of elastic and plastic deformation, creep, fracture, and fatigue failure, as applied to metals, ceramics, composites, thin film and biological materials.
- Provide a thorough introduction to the principles of fracture mechanics.
- Provide practical examples of the application of fracture mechanics to design and life prediction methods and reporting. Provide a basis for the use of fractography as a diagnostic tool for structural failures.

UNIT-I

Introduction: Fracture behaviour of metals and alloys. The ductile/brittle transition temperatures for notched and un-notched components, Ductile rupture as a failure mechanism Fracture at elevated temperature.

Definitions of types of fracture and failure, Introduction to stress intensity factor and strain energy release rate, Equivalence of energy approach and stress intensity approach.

Basic Stress Analysis and Mechanical Properties: Elasticity, General 3-D relations, Plane stress and plane strain, Mohr's circle-principal stresses, Yield in materials, Tresca and Von Mises criteria, Ideal and actual strength of materials. Typical stress/strain curves for different classes of materials.

UNIT-II

Stress Intensity Factor and its use in Fracture Mechanics: Early concepts of stress concentrators and flaws, Ingles solution to stress round an elliptical hole-implications of results. Stress intensity factor for a crack. Westergaard's solution for crack tip stresses. Stresses and displacement in Cartesian and polar coordinates, Linear Elastic Fracture Mechanics. Typical values of fracture toughness, Different modes of crack opening. Superposition of crack tip stress fields, Direction of crack growth under mixed mode loadings.

Crack tip plasticity, Early estimates of plastics zone, Irwin plastic zone correction and Dugdale approach, Plastic zone shape in three dimensions and shape under plane stress and plane strain conditions, Allowable plasticity for LEFM to apply, the thickness criterion Experimental methods for measuring Kic.

UNIT-III

Elastic/Plastic Fracture Mechanics: Elastic/plastic fracture mechanics: The crack opening displacement and J-integral approaches, R-curve analysis Testing procedures, Measurement of these parameters, RAD, Fail sage and safe life design approaches, Practical applications. Advanced to pics in EOFM.

UNIT-IV

Fatigue: Importance of fatigue in engineering, Low cycle fatigue, Coffin-Manson law, Cyclic work hardening and softening. Micro structural models of crack initiation. Stage I, II and III crack growth.

Analysis of Fatigue: The empirical laws of fatigue failure. High cycle-low strain fatigue, Basquin's law, Goodman, Soderberg and Gerber mean stress corrections, Miner's law of damage summation. Low cycle fatigue, Crack growth and application of fracture mechanics to fatigue, Paris-Ergodan law, Threshold stress intensity range. Crack closure and its theories Cycle counting methods, Developments in using rain-flow counting methods to recreate fatigue standard spectra. Standard spectra suitable for different applications.

UNIT-V

Fatigue Of Welded Structures: Factors affecting the fatigue lives of welded joints, the codes and standards available to the designer, the use of fracture mechanics to supplement design rules. Practical examples.

Creep: Phenomenology, Creep curves, Creep properties, Multi-axial creep, Creep-fatigue interaction, Creep integrals.

TEXT BOOKS:

1. Mechanical Metallurgy / Dieter / McGraw Hill
2. Fracture Mechanics: Fundamental and Applications /Anderson T.L & Boca Raton/ . CRC Press, Florida, 1998.
3. Deformation and Fracture mechanics of Engineering Materials / Richard W Hertz . /Wiley

REFERENCE BOOKS:

1. Plasticity for structural Engineers / W.F. Chen and D.J,. Ha,
2. Engineering Fracture Mechanics/ D.R.J. Owen and A.J. Fawkes /Pincridge press, . Swansea, U.K.
3. Fracture and fatigue control in structures/ S.T. Rolfe and J.M. Barsom/ Printice Hall, Englewood cliffs, N.J..

OUTCOMES:

The Student will be:

- Able to use simple continuum mechanics and elasticity to determine the stresses, strains, and displacements in a loaded structure. Able to do mathematical modeling of the elements of plastic deformation, with respect to continuum and microscopic mechanisms.
- Able to use creep data to predict the life of structures at elevated temperatures and the understanding of mechanisms of creep deformation and fracture.
- Able to quantitatively estimate failure criteria for both elastically and plastically deforming structures, in the design of life prediction strategies, and for fracture control plans, with examples from automotive, aerospace, medical, and other industries.

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(R15D1504) ADVANCED FINITE ELEMENT ANALYSIS (ELECTIVE–I)

Objectives:

- Apply vector mechanics as a tool for problem solving.Understand the need in Design for the Finite Element Method.
- Tie his/her understanding of mechanical engineering design concepts to use the . Finite Element Method software correctly and efficiently.
- Analyze a physical problem, develop experimental procedures for accurately investigating the problem, and effectively perform and document findings.Understand forces associated with different parts of a machine

UNIT-I

Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Glerkin's Methods. Coordinates, basic element shapes, interpolation function, Virtual energy principle, Rayleigh – Ritz method, properties of stiffness matrix, treatment of boundary conditions, solution of system of equations, shape functions and characteristics, Basic equations of elasticity, strain- displacement relations.

UNIT-II

1-D Structural Problems: Axial bar element – stiffness matrix, load vector, temperature effects, Quadratic shape functions and problems. ANALYSIS OF TRUSSES : Plane Trusses and Space Truss elements and problems ANALYSIS OF BEAMS : EFA Hermite shape functions – stiffness matrix – Load vector – Problems.

UNIT-III

2-D Problems: CST, LST, force terms, Stiffness matrix and load vectors, boundary conditions, Isoparametric elements – quadrilateral element, shape functions – Numerical Integration. Finite element modelling of Axi-symmetric solids subjected to Axi-symmetric loading with triangular elements. 3-D PROBLEMS: Tetrahedran element – Jacobian matrix – Stiffness matrix.

UNIT-IV

Scalar Field Problems: 1-D Heat conduction-Slabs – fins - 2-D heat conduction problems – Introduction to Torsional problems.

UNIT-V

Dynamic Considerations: Dynamic equations – consistent mass matrix – Eigen Values, Eigen vector, natural frequencies – mode shapes – modal analysis.

TEXT BOOKS:

1. The Finite Element Methods in Engineering / SS Rao / Pergamon.
2. Finite Element Methods: Basic Concepts and applications, Alavala, PHI
3. Introduction to Finite Elements in Engineering, Chandrupatla, Ashok and Belegundu, Prentice – Hall

REFERENCE BOOKS:

1. Finite Element Method – Zienkiewicz / Mc Graw Hill
2. Introduction to Fininte element analysis- S.Md.Jalaludeen,Anuradha Publications, print-2012
3. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th . Edition

OUTCOMES:

After Completion of this course students will be able to

- Numerical methods involved in Finite Element Theory. Definition of truss, beam, membrane, plate, and continuum elements. Formulation of planar one dimensional (truss and beam) elements having linear, quadratic, and cubic shape functions.
- Global, local, and natural coordinates. Formulation of planar, plane stress two-dimensional elements (rectangular and quadratic quadrilateral elements).
- Formulation of 3-dimensional elements (four node tetrahedral and eight-node brick elements).Direct formulation and basic energy and weighted residual formulation of finite elements. Procedures for performing and verifying FEA using commercial FEA software

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(R15D1505) GEAR ENGINEERING
(Design Data Book Permitted)
(ELECTIVE–I)

Objectives:

- To develop an ability to design a system, component, or process to meet desired needs with in realistic constraints.
- To develop an ability to identify, formulate, and solve engineering problems.
- To develop an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

UNIT–I

Introduction: Principles of gear tooth action, Generation of Cycloid and Involute gears, Involutometry, gear manufacturing process and Inspection, gear tooth failure modes, stresses, selection of right king of gears.

Spur Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of spur gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load. Design of gear shaft and bearings.

UNIT–II

Helical Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of helical gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load. Design of gear shaft and bearings.

Gear Failures: Analysis of gear tooth failures, Nomenclature of gear tooth wear and failure, tooth breakage, pitting, scoring, wear, overloading, gear-casing problems, lubrication failures.

UNIT–III

Worm Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of worm gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load. Heat dissipation consideration. Design of gear shaft and bearings.

UNIT–IV

Bevel Gears: Tooth loads, Principles of Geometry, Design considerations and methodology, Complete design of bevel gear teeth considering Lewis beam strength, Buckingham's dynamic load and wear load. Design of gear shaft and bearings.

UNIT–V

Gear Trains: Simple, compound and epicyclic gear trains, Ray diagrams, Design of a gearbox of an automobile, Design of gear trains from the propeller shafts of airplanes for auxiliary systems.

Optimal Gear Design: Optimization of gear design parameters. Weight minimization, Constrains in gear train design-space, interference, strength, dynamic considerations, rigidity etc. Compact design of gear trains, multi objective optimization of gear trains. Application of Traditional and non-traditional optimization techniques.

TEXT BOOKS:

1. Machine Design/ Maleev and Hartman/ C.B.S Publishers, India.
2. Gear engineering/ Henry E.Merrit / Wheeler publishing, Allahabad. 1992.
3. Practical Gear design/ Darle W.Dudley/ McGraw-Hill book company.

REFERENCE BOOKS:

1. Analytical mechanics of gears/ Earle Buckingham/ Dover publications, New York, . 1949.
2. Hand book of gear design/ G.M.Maitha / Tata McGraw Hill publishing company Ltd, . New Delhi, 1994.
3. Machine Design / Shaum series / McGraw Hill.

OUTCOMES:

After Completion of this course students will get

- Ability to select appropriate materials for a design, considering manufacturability, availability, cost,performance, suitability for the conditions, potential failure modes, environmental impact, and other considerations.
- Ability to evaluate the importance of an engineering decision, select an appropriate decision making process, and implement that process to make a defensible engineering decision.
- Ability to model, analyze, design, and realize a mechanical system that meets a particular need.

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(R15D1506) THEORY OF ELASTICITY AND PLASTICITY (ELECTIVE–I)

Objectives:

- To understand the theory of stress, strain and plasticity and enlighten the advances in plasticity and plastic strain analysis.
- To obtain the stress strain relation within the elastic body and find the principle stress and strain for a different types of elastic body.
- To known yield criteria for ductile metal and to understand the plastic stress-strain relations and learn Upper and lower bound theorems and corollaries.

UNIT-I

Elasticity: Two dimensional stress analysis - Plane stress - Plane strain - Equations of compatibility - Stress function - Boundary conditions.

Problem in Rectangular Coordinates - Solution by polynomials - Saint Venent's principles - Determination of displacement - Simple beam problems.

Problems in Polar Coordinates - General equations in polar coordinates - Stress distribution symmetrical about axis - Strain components in polar coordinates - Simple and symmetric problems.

UNIT-II

Analysis of Stress and Strain in Three Dimensions: Principle stresses - Homogeneous deformations - Strain spherical and deviatoric stress - Hydrostatic strain.

General Theorems: Differential equations of equilibrium and compatibility - Displacement - Uniqueness of solution - Reciprocal theorem.

UNIT-III

Bending of Prismatic Bars: Stress function - Bending of cantilever beam - Beam of rectangular cross-section - Beams of circular cross-section.

UNIT-IV

Plasticity: Plastic deformation of metals - Structure of metals - Deformation - Creep stress relaxation of deformation - Strain rate condition of constant maximum shear stress - Condition of constant strain energy - Approximate equation of plasticity.

UNIT-V

Methods of Solving Practical Problems: The characteristic method - Engineering method - Compression of metal under press - Theoretical and experimental data drawing.

TEXT BOOKS:

1. Theory of Elasticity/Timoshenko S.P. and Goodier J.N./Koakusha Publishers
2. An Engineering Theory of Plasticity/E.P. Unksov/Butterworths
3. Applied Elasticity/W.T. Wang/TMH

REFERENCE BOOKS:

1. Theory of Plasticity for Engineers/Hoffman and Sacks/TMH
2. Theory of Elasticity and Plasticity/Sadhu Singh/ Khanna Publishers
3. Theory of Elasticity and Plasticity/Harold Malcolm Westergaard/Harvard University . Press

OUTCOMES:

After Completion of this course students will be able to

- Understand the stress and strain tensor field.Understand the contact stresses analysis problem in bearing.
- Understand advanced concepts of plasticity and plastic deformation analysis
- Students can demonstrate Idealized stress-strain diagrams for different material models and demonstrate experimental verification of the Prandtl-Reuss equation

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(R15D1507) ADVANCED MECHANICS OF COMPOSITE MATERIALS (ELECTIVE–II)

Objectives:

The objective for this course is

- To develop an understanding of the linear elastic analysis of composite materials.
- To understanding will include concepts such as anisotropic material behavior and the analysis of laminated plates.
- The students will undertake a design project involving application of fiber reinforced laminates.

UNIT–I

Basic Concepts and Characteristics: Geometric and Physical definitions, natural and man-made composites, Aerospace and structural applications, types and classification of composites.

Reinforcements: Fibres – Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide fibres. Particulate composites, Polymer composites, Thermoplastics, Thermostats, Metal matrixand ceramic composites.

UNIT–II

Micromechanics: Unidirectional composites, constituent materials and properties, elastic properties of a lamina, properties of typical composite materials, laminate characteristics and configurations. Characterization of composite properties.

Manufacturing Methods: Autoclave, tape production, moulding methods, filament winding, manlayup, pultrusion, RTM.

UNIT–III

Coordinate Transformation: Hooke's law for different types of materials, Hooke's law for two dimensional unidirectional lamina, Transformation of stress and strain, Numerical examples of stress strain transformation, Graphic interpretation of stress – strain relations. Off –axis, stiffness modulus, off – axis compliance.

Elastic Behavior of Unidirectional Composites: Elastic constants of lamina, relation ship between engineering constants and reduced stiffness and compliances, analysis of laminated composites, constitutive relations.

UNIT–IV

Strength of Unidirectional Lamina: Micro mechanics of failure, Failure mechanisms, strength of an orthotropic lamina, strength of a lamina under tension and shear maximum stress and strain criteria, application to design. The failure envelope, first ply failure, free-edge effects. Micros mechanical predictions of elastic constants.

UNIT–V

Analysis of Laminated Composite Plates:

Introduction thin plate theory, specially orthotropic plate, cross and angle ply laminated plates, problems using thin plate theory.

TEXT BOOKS:

1. Mechanics of Composite Materials/ R. M. Jones/ Mc Graw Hill Company, New . York,1975.
2. Engineering Mechanics of Composite Materials by Isaac and M Daniel, Oxford . University Press,1994.
3. Analysis and performance of fibre Composites/ B. D. Agarwal and L. J. Broutman/ . Wiley Interscience, New York, 1980.

REFERENCE BOOKS:

1. Mechanics of Composite Materials/ Second Edition (Mechanical Engineering)/ Autar K.Kaw Publisher: CRC
2. Analysis of Laminated Composite Structures/ L. R. Calcote/ Van Nostrand Rainfold, NewYork, 1969.
3. Advanced Mechanics of Composite Materials/ Vasiliev &Morozov/Elsevier/Second . Edition

OUTCOMES:

- Students who successfully complete the course will demonstrate the following outcomes by tests, homework, and design project. An ability to identify the properties of fiber and matrix materials used in commercial composites, as well as some common manufacturing techniques.An ability to predict the elastic properties of both long and short fiber composites based on the constituent properties.An ability to rotate stress, strain and stiffness tensors using ideas from matrix algebra.
- A basic understanding of linear elasticity with emphasis on the difference between isotropic and anisotropic material behavior.An ability to analyze a laminated plate in bending, including finding laminate properties from lamina properties and find residual stresses from curing and moisture.
- An ability to predict the failure strength of a laminated composite plate.A knowledge of issues in fracture of composites and environmental degradation of composites. An exposure to recent developments in composites, including metal and ceramic matrix composites.An ability to use the ideas developed in the analysis of composites towards using composites in aerospace design.

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(R15D1508) ADVANCED COMPUTER AIDED DESIGN (ELECTIVE–II)

Objectives:

- Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings, understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.
- Improve visualization ability of machine components and assemblies before their actual fabrication through modeling, animation, shading, rendering, lighting and coloring. Model complex shapes including freeform curves and surfaces.
- Integrate the CAD system and the CAM system by using the CAD system for modeling design Information and converting the CAD model into a CAM model for modeling the manufacturing Information.Use full-scale CAD/CAM software systems designed for geometric modeling of machine Components and automatic generation of manufacturing information.

UNIT-I

Principles of Computer Graphics : Introduction, graphic primitives, point plotting, lines, Bresenham's circle algorithm, ellipse, transformation in graphics, coordinate systems, view port,2D and 3D transformation, hidden surface removal, reflection, shading and generation of characters.

UNIT-II

Cad Tools: Definition of CAD Tools, Types of system, CAD/CAM system evaluation criteria, brief treatment of input and output devices. Graphics standard, functional areas ofCAD, Modeling and viewing, software documentation, efficient use of CAD software.

Geometric Modelling: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves her mite cubic splines Beziercurves B-splines rational curves.

UNIT-III

Surface Modeling: Mathematical: representation surfaces, Surface model, Surface entities surface representation, Parametric representation of surfaces, plane surface, rule surface, surface of revolution, Tabulated Cylinder.

UNIT-IV

Parametric Representation of Synthetic Surfaces: Hermite Bicubic surface, **Bezier** surface, **B-** Spline surface, COONs surface, Blending surface Sculptured surface, Surface manipulation — Displaying, Segmentation, Trimming, Intersection, Transformations (both 2D and 3D).

UNIT-V

Geometricmodelling-3D: Solid modeling, Solid Representation, Boundary Representation (13-rep), Constructive Solid Geometry (CSG).**CAD/CAM.**

Exchange : Evaluation of data - exchange format, IGES data representations and structure, STEP Architecture, implementation, ACIS & DXF. Design Applications: Mechanical tolerances, Mass property calculations, Finite Element Modeling and Analysis and Mechanical Assembly.

Collaborative Engineering: Collaborative Design, Principles, Approaches, Tools, Design Systems.

TEXT BOOKS:

1. Mastering CAD/CAM / Ibrhim Zeid / Mc Graw Hill International.
2. CAD/CAM Principles and Applications/ P.N.Rao/TMH/3rd Edition
3. CAD/CAM /Groover M.P./ Pearson education

REFERENCE BOOKS:

1. CAD/CAM Concepts and Applications/ Alavala/ PHI
2. CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age
3. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson

OUTCOMES:

After Completion of this course students will be able to

- Understand the concepts of wireframe, surface and solid modeling and part modeling and part data exchange standards (VDA, IGES, and STEP).
- Develop knowledge in 2D-Transformations, 3D Transformations and the Assembly Modeling, Assembly tree, and Assembly Methods.
- The Students become experts on Visualization and computer animation Techniques.

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(R15D1509) APPLIED TRIBOLOGY
(ELECTIVE-II)

Objectives:

- Understanding the principles for selecting compatible materials for minimizing friction and wear in machinery and the principles of bearing selection and bearing arrangement in machines.
- Learn the computations required for selecting and designing bearings in machines and the fundamental principles of lubrication for reduction of friction and Wear.
- Understanding the fundamental principles of high contact stresses (Hertz stresses), Fatigue-failure and Elasto hydrodynamic (EHD) lubrication in rolling bearings and gears.

UNIT-I

Historical Background - Viscosity - Viscometry - Effect of temperature on viscosity - Effect of pressure in viscosity - Other physical properties of mineral oils - The generalized Reynolds equation - Flow and shear stress - The energy equation - The equation of state - Mechanism of pressure development.

UNIT-II

Circumferential Flow - Oil flow through a bearing having a circumferential oil groove - Heat generation and lubricant temperature - Heat balance and effective temperature - Bearing design: Practical considerations - Design of journal bearings - Parallel surface bearing - Step bearing - Some situations under squeeze film lubrication - The mechanism of hydrodynamic instability - Stiffness and damping coefficients - Stability.

UNIT-III

Elasto Hydrodynamic Lubrication: Theoretical consideration - Grubin type solution - Accurate solution - Point contact - Dimensionless parameters - Film thickness equations - Different regimes in EHL contact - Deep-groove radial bearings - Angular contact bearings - Thrust ball bearings - Geometry - Kinematics - Stress and deformations - Load capacity.

UNIT-IV

Surface Topography - Surface characterization - Apparent and real area of contact - Derivation of average Reynolds equation for partially lubricated surface - Effect of surface roughness on journal bearings

UNIT-V

Laws of Friction - Friction theories - Surface contaminants - Frictional heating - Effect of sliding speed on friction - Classification of wear - Mechanisms of wear - Quantitative laws of wear - Wear resistance materials.

TEXT BOOKS:

1. Rowe WW& O' Dionoghue,||Hydrostatic and Hybrid bearing design — Butterworths . & Co.Publishers Ltd,1983.
2. Collacott R.A,|| Mechanical Fault diagnosis and condition monitoring||, Chapman and Hall, London 1977.
3. Bernard J.Hamrock, — Fundamentals of fluid film lubricant||, Mc Graw-Hill Co.,1994.

REFERENCE BOOKS:

1. Neale MJ, (Editor) — Tribology hand Book||Neumann Butterworths, 1975.
2. Connor and Boyd JJO (Editors) — Standard hand book of lubrication engineers — . ASLE,Mc
3. Introduction to Tribology of Bearings by Majumdar, B.C

OUTCOMES:

After Completion of this course students will be able to

- Students will demonstrate basic understanding of friction, lubrication and wear processes and familiar with mathematical tools used to analyze tribological processes.
- Students will become familiar with common anti-friction and anti-wear components . and the lubricants used therein.
- Students will be able to describe the detailed operation of selected anti-friction or . anti wear components.

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(R15D1510) COMPUTATIONAL METHODS IN ENGINEERING (OPEN ELECTIVE-I)

Objectives:

- The objective of this course is to teach students mathematical derivations, implementation in a computer code, typical characteristics, advantages, disadvantages and limitations of appropriate numerical methods to solve a range of mathematical problems encountered in the practice of advanced engineering.
- Finding solution to non-linear equations. Computing numerical derivatives and integrals for complex functions and discrete engineering data.
- Finding solutions to systems of linear equations and non-linear equations. Approximating data using mathematical functions and finding solutions of ODEs and PDEs under different boundary and initial conditions.

UNIT-I

Introduction to Numerical Methods Applied to Engineering PROBLEMS: Examples, solving sets of equation – Matrix notation – Determination and inversion – Iterative methods – Relaxation methods – System of non-linear equations – computer programs. Numerical integration: Newton-Cotes integration formulas – Simpson's rules, Gaussian quadrature. Adaptive integration.

UNIT-II

Optimization: One dimensional unconstrained optimization, multidimensional unconstrained optimization – direct methods and gradient search methods, constrained optimization. Boundary value problems and characteristic value problems: Shooting method – Solution through a set of equations – Derivative boundary conditions – Rayieigh - Ritz method – Characteristic value problems,

UNIT-III

Numerical Solutions of Partial Differential Equations: Laplace's equations – Representation as a difference equation – Iterative methods for Laplace's equations – poisson equation – Examples – Derivative boundary conditions – Irregular and non-rectangular grids – Matrix patterns, sparseness – ADI method – Finite element method. Parabolic partial differential equations: Explicit method – Crank-Nickelson method – Derivative boundary condition – Stability and convergence criteria – Finite element for heat flow – computer programs.

UNIT-IV

Hyperbolic Partial Differential Equations: Solving wave equation by finite differences stability of numerical method – method of characteristics wave equation in two space dimension-computer programs. Curve fitting and approximation of functions: Least square approximation fitting of non-linear curves by least squares – regression analysis – multiple linear regression, non linear regression – computer programs.

UNIT-V

Turbulence Models and Mesh Generation: Turbulence models, mixing length model, Two equation (k-Є) models – High and low Reynolds number models – Structured Grid generation – Unstructured Grid generation – Mesh refinement – Adaptive mesh – Software tools.

TEXT BOOKS:

1. Numerical Methods for Engineers/ Steven C.Chapra, Raymond P.Canale/ Tata Ma-Graw Hill
2. Applied numerical analysis / Curtis F.Gerald, partick.O.Wheatly /Addison-. wesley,1989
3. Numerical methods / Douglas J.Faires, Riched Burden / Brooks-cole publishing . company, 1998 Second edition.

REFERENCE BOOKS:

1. Numerical mathematics and computing/ Ward cheney & David Kincaid / Brooks-cole publishing company 1999 fourth edition
2. Mathematical methods for physics and engineering / Riley K.F.M.P.Hobson & Bence . S.J./ Cambridge university press,1999.
3. Computational Methods In Engineering by Prasanna Swaminathan , S.P. Venkateshan

OUTCOMES:

After Completion of this course students will be able to

- Understand and estimate errors due to round-off in the computer representation of numbers and errors in the numerical methods due to truncation and their implications to the stability and accuracy of the computational results.
- Compute the roots of non-linear equations and solve systems of linear equations. using appropriate numerical methods for the given problem. Perform numerical integration and differentiation for a given function using a suitable numerical method.
- Perform interpolation, extrapolation, and curve-fitting for a set of data using different numerical methods Solve several types of ODEs and PDEs with various boundary conditions using numerical techniques .Use a computer language of their choice to solve problems using numerical methods covered in the course.

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(R15D1511) CONCURRENT ENGINEERING
(OPEN ELECTIVE - I)

Objectives:

- To familiarize with the basics of concurrent engineering and the tools and methodologies available in CE
- Various approaches to CE and the other related aspects of CE
- critically analyses alternative spacecraft design configuration and option CE and dentify information requirements and sources for spacecraft design and evaluation CE

UNIT-I

Introduction: Background and challenges faced by modern production environment, sequential engineering process, Concurrent engineering definition and requirement, meaning of concurrent objectives of CE, benefits of CE, Life cycle design of products, life cycle costs. Support for CE: Classes of support for CE activity, CE organizational, structure CE, team composition and duties, Computer based Support, CE Implementation Process.

UNIT-II

Design Product for Customer: Industrial Design, Quality Function Deployment, house of quality, Translation process of quality function deployment (QFD). Modeling of Concurrent Engineering Design: Compatibility approach, Compatibility index, implementation of the Compatibility model, integrating the compatibility Concerns.

UNIT-III

Design for Manufacture (DFM): Introduction, role of DFM in CE, DFM methods, e.g. value engineering, DFM guidelines, design for assembly, creative design methods, product family themes, design axioms, Taguchi design methods, Computer based approach to DFM. Evaluation of manufacturability and assimilability.

UNIT-IV

Quality by Design : Quality engineering & methodology for robust product design,Parameter and Tolerance design, Quality loss function and signal to noise ratio for designing the quality, experimental approach.

UNIT-V

Design for X-ability: Design for reliability, life cycle serviceability design, design for maintainability, design for economics, and decomposition in concurrent design, concurrent design case studies.

TEXT BOOKS:

1. Concurrent Engineering- Kusiak - John Wiley & Sons
2. Concurrent Engineering- Menon - Chapman & Hall
3. Concurrent Engineering Fundamentals; Integrated Product Development, VO1. I and II, Biren Prasad, Prentice Hall, New Jersey

REFERENCE BOOKS:

1. Concurrent Engineering /Johan R Hartley/productivity press.
2. Concurrent Engineering; concepts, Implementation and practice/chanan&Menon/ Chapman Hall
3. Concurrent Engineering by Susan Carlson Skalak

OUTCOMES:

- The graduates shall have the ability to understand the importance of product design in leveraging both manufacturing cost and product lifecycle cost and the graduates shall have the ability to plan and implement a product development program. The graduates shall have the ability to define product architecture and design products for maximum economic impact
- The graduates shall have the ability to participate in multidiscipline Integrated Product Development teams and he graduates shall have the ability to both write effective documents and deliver effective oral presentations.
- The graduates shall have the ability to benchmark competitive products and develop best industry practices and he graduates shall have the ability to determine customer needs and define product pecifications that meet professional ethical standards and the graduates shall have the ability to design and conduct experiments to ensure that the product design is robust and compatible with the capability of the manufacturing process.

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L	T/P/D	C
4	0	3

(R15D1512) DATA BASE MANAGEMENT SYSTEM (OPEN ELECTIVE - I)

Objectives:

- Articulate how data is stored in both primary and secondary storage. Explain database management system architecture
- Identify, describe, and categorize database objects. Design and implement advanced queries using Structured Query Language
- Design and implement a complete problem solution using current database technology.

UNIT-I

Database System Applications, database system VS file system- view of data- data abstraction –instances and schemas – data models – the ER Model – Relational model – other models –Database languages – DDL – DML – database Access for applications programs – database users and administrator – transaction management – database system structure – storage manager – the query processor – history of database systems – database design and ER diagrams – Beyond ER design entities of ER model – concept design with the ER model –conceptual design for large enterprises.

UNIT-II

Relational model: introduction to the relational model – integrity constraint over relations – enforcing integrity constraints – querying relational data – logical database design – introduction to views – destroying / altering tables and views.

Relational Algebra and Calculus : relational algebra – selection and projection set operations –renaming – joins – division – examples of algebra overviews – relational calculus – tuple relational calculus – domain relational calculus – expressive power of algebra and calculus.

UNIT-III

Form of basic SQL Query – examples of basic SQL Queries – introduction to nested queries – correlated nested queries set – comparison operators – Aggressive operators -Null values – comparison using null values – logical connectivity's – AND, OR and NOTR – impact on SQL constructs – Outer joins – disallowing NULL values – complex integrity constraints in SQL Triggers and Active Database. Schema refinement – problems caused by redundancy – decompositions – problem related to decomposition – reasoning about FDS – FIRST, SECOND, THIRD Normal forms – BCNF –Lossless join decomposition – Dependency preserving Decomposition – Schema refinement in database design – Multi valued dependencies – forth Normal Form.

UNIT-IV

Overview of transaction management: ACID properties – Transactions and schedules – concurrent execution of transaction – lock based concurrency control – performance locking – transaction support in SQL – Introduction to crash recovery.

Concurrency Control: serializability and recoverability – introduction to lock management – lock conversions dealing with dead locks – specialized locking techniques concurrency without locking.

Crash recovery : introduction to ARIES – the log – other recovery related structures – the write-Ahead Log Protocol – check pointing – recovering form a system crash – media recovery – other approaches and interaction with concurrency control.

UNIT-V

OVERVIEW OF STORAGE AND INDEXING : data on external storage – File organization and indexing – cluster indexing, primary and secondary indexes – index data structures – hash based indexing tree base indexing –comparison of file organizations – indexes and performance Tuning.

Storage data: Disks and Files: the Memory Hierarchy – redundant Arrays of independent – Disks – disk space management – buffer manager – files of records – page formats – record formats.

Tree structure Indexing : introduction for tree indexes – indexed sequential access methods(ISAM)-B+ Tress: A dynamic Index structure.

Hash based Indexing: Static Hashing – extendable hashing – Linear Hashing – Extandable vs.Linear hashing.

TEXT BOOKS:

1. Database Management Systems/ Raghurama Krishnan, Johannes Gehrke/ TATA . McGraw hills 3rd Edition.
2. Database systems Concepts/ Silberschatz, Korth/ McGraw hill, IV Edition
3. Database Management Systems/ P.Radha Krishna/ Hi-TECH Publications 2005

REFERENCE BOOKS:

1. Database Management Systems/ Elmasri Navrate/ Pearson Education.
2. Database Management Systems /Mathew Leon, Leon Vikas/
3. Database Systems / Connoley/ Pearson Education.

OUTCOMES:

Students get

- Ability to function effectively as an individual and in multi-disciplinary and multi- . cultural teams, with the capacity to be a leader or manager as well as an effective . team member .
- Understanding of the social, cultural, global and environmental responsibilities of the professional Engineer, and the principles of sustainable design and development.
- Understanding of and commitment to professional and ethical responsibilities . Expectation and capacity to undertake lifelong learning.

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L	T/P/D	C
-	3	2

(R15D1581) KINEMATICS AND DYNAMICS LABORATORY

Objectives:

- To equip students with understanding of the fundamental principles and techniques for Identify different types of dynamic systems and classify them by their governing equations.
- To develop a model of a mechanical system using a free body diagram and develop equations of motion for translational and rotational mechanical systems.
- To develop an understanding of how property data is generated and reported and to create a bridge between theoretical knowledge and application.

LIST OF EXPERIMENTS:

1. Determination of damped natural frequency of vibration of the vibrating system with different viscous oils.
2. Determination of steady state amplitude of a forced vibratory system.
3. Static balancing using steel balls.
4. Determination of the magnitude and orientation of the balancing mass in dynamic balancing.
5. Field balancing of the thin rotors using vibration pickups.
6. Determination of the magnitude of gyroscopic couple, angular velocity of precession and representation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer.
8. Diagnosis of a machine using FFT analyzer.
9. Study of un damped natural frequencies
10. Study of frequencies with various springs arranged in series and parallel

(A Minimum of 10 experiments are to be conducted)

OUTCOMES:

As an outcome of completing this course, students will be able to:

- Plan, conduct, analyze and evaluate experiments.
- Compare analytical and theoretical results.
- To Produce reports ,Communicate test results through presentation (graphical or oral).

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L	T/P/D	C
-	3	2

(R15D1582) TECHNICAL SEMINAR

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L	T/P/D	C
4	0	3

(R15D1513) ADVANCED MECHANICS OF MACHINERY

Objectives:

- Understand the basic principles and concepts of Mechanical Design. Define the physics that govern behavior.
- Examine the suitability of mechanical devices/products for specific applications.
- Understand the various quantitative and qualitative approaches to synthesis and modeling of compliant mechanisms.

UNIT–I

Advanced Kinematics of Plane Motion- I: Introduction to plane motion. The Inflection circle, Euler – Savary Equation, Analytical and graphical determination of di , Bobillier's Construction , Collineation axis , Hartmann's Construction ,Inflection circle for the relative motion of two moving planes, Application of the Inflection circle to kinematic analysis.

UNIT-II

Advanced Kinematics of Plane Motion - II: Polode curvature, Hall's Equation, Polode curvature in the four bar mechanism, coupler motion, relative motion of the output and input links, Determination of the output angular acceleration and its Rate of change, Freudenstein's collineation –axis theorem, Carter –Hall circle, The circling – point curve for the Coupler of afour bar mechanism.

UNIT-III

Introduction to Synthesis-Graphical Methods - I: The Four bar linkage ,Guiding a body through Two distinct positions, Guiding a body through Three distinct positions, The Roto center triangle , Guiding a body through Four distinct positions, Burmester's curve.

UNIT-IV

Introduction to Synthesis-Graphical Methods - II: Function generation- General discussion, Function generation: Relative – Roto center method, Overlay's method, Function generation- Velocity – pole method, Path generation: Hrones's and Nelson's motion Atlas, Roberts's theorem.

UNIT–V

Introduction to Synthesis - Analytical Methods: function generation: Freudenstien's equation, Precision point approximation, Precision – derivative approximation, Path Generation: Synthesis of Four-bar Mechanisms for specified instantaneous condition, Method of components, Synthesis of Four-bar Mechanisms for prescribed extreme values of the angular velocity of driven link, Method of components.

TEXT BOOKS:

1. Kinematics and Dynamics of plane mechanisms/ Jeremy Hirschhorn/McGraw-. Hill,1962.
2. Theory of Machines and Mechanisms/ J.E Shigley and J.J . Uicker Jr./ McGraw-Hill, . 1995
3. Theory of Mechanisms and Machines/ Amitabh Ghosh and Ashok Kumar Mallik/ E.W.P.Publishers.

REFERENCE BOOKS:

1. Kinematics and Linkage Design/ Allen S.Hall Jr./ PHI,1964.
2. Kinematics and Dynamics of Machinery/Charles E Wilson/Pearson/3rd Edition
3. Mechanics of Machines by Viswanatha Ramamurti

OUTCOMES:

- Understand the metrics that are used to determine/set desired performance.
- Understand the physics that govern the behavior of compliant mechanisms.
- Identify the practical issues that are important to address during integration and implementation.

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L	T/P/D	C
4	0	3

(R15D1514) DESIGN SYNTHESIS

Objective:

- Competence with a set of tools and methods for product design and development and confidence in own abilities to create a new product.
- Awareness of the role of multiple functions in creating a new product (e.g. marketing, finance, industrial design, engineering, production).
- Ability to coordinate multiple, interdisciplinary tasks in order to achieve a common objective.

UNIT-I

Design process and methodologies of systematic design conceptual design variants and evaluation Standardization and its exploitation in design.

UNIT–II

Tolerance from process and function, interchangeability and selective assembly, selection of fits for different design situations, surface finish. Load transmission, load equalization light weigh and rigid constructions.

UNIT–III

Design of case, forged sheet metal parts and welded constructions Machine considerations.

UNIT–IV

Design for assembly and dismantling Modular constructions erection, operation inspection and maintenance considerations, Ergonomics Design of accuracy Location pins and registers, Machining in assembly, adjustment, Backlash and Clearance adjustment.

UNIT–V

Problems formulation for design optimization Example illustration the various principles available design variants for some of the common basic functional requirements.

TEXT BOOKS:

1. Engineering Design a systematic approach/ G. Phal W. Beitz/ Springer /3rd Edition
2. Engineering Design a material and processing approach/ George Dieter/ McGraw . Hi8ll international book company 1983
3. Engineering Design Synthesis: Understanding, Approaches and Tools edited by . Amaresh Chakrabarti.

REFERENCE BOOKS:

1. Mechanical Design Theory Methodology/ Manjula B. Waldron and Kenneth J. Waldron/Springer Verlag New York 1996.
2. Design Synthesis: Integrated Product and Manufacturing System Design Graeme Arthur Britton, Seppo Torvinen.
3. Formal Engineering Design Synthesis By Erik K. Antonsson, California Institute of . Technology & Jonathan Cagan , Carnegie Mellon University, Pennsylvania.

OUTCOMES:

Understand a product design brief

- Know how to communicate product design ideas and concepts.
- Be able to develop product design proposals
- Be able to realize outcomes to a design brief.

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L	T/P/D	C
4	0	3

(R15D1515) EXPERIMENTAL STRESS ANALYSIS

Objectives:

- To understand the relation between the mechanics theory and experimental stress analysis and to establish the fundamental concepts and newly experimental techniques.
- To be able to use the experimental techniques on the practical problems.
- To be able to make a fine presentation related to the experimental paper.

UNIT-I

Introduction: Theory of Elasticity, Plane stress and plane strain conditions, compatibility conditions, problem using plane stress and plane strain conditions, three-dimensional stress strain relations.

Strain Measurement Methods: various types of strain gauges, electrical resistance strain gauges, semiconductor strain gauge circuits.

UNIT-II

Recording Instruments: Introduction, static recording and data logging, dynamic recording at very low frequencies, dynamic recording at intermediate frequencies, dynamic recording at high frequencies, dynamic recording at very high frequencies, telemetry systems.

UNIT-III

Brittle Coatings: Introduction, coating stresses, failure theories, brittle coating crack patterns, crack detection, ceramic based brittle coatings, resin based brittle coatings, test procedures for brittle coatings analysis, calibration procedures, analysis of brittle coating data.

Moire Methods: Introduction, mechanism of formation of Moire fringes, the geometrical approach to moiré-fringe analysis, the displacement field approach to Moire-fringe analysis, out of plane displacement measurements, out of plane slope measurements, sharpening and multiplication of moiré-fringes, experimental procedure and techniques.

UNIT-IV

Photo Elasticity: Photo elasticity, polariscope, plane and circularly polarized light, bright and dark filed setup, photo elasticity materials,, Isochromatic fringes – Isoclinics.

UNIT-V

Three Dimensional Photo Elasticity: Introduction, locking in model deformation,materials for three dimensional photo elasticity, machining cementing and slicing three dimensional models, slicing the model and interpretation of the resulting fringe patterns, effective stresses, the shear-difference method in three dimensions, applications of the Frozen-stress method, the scattered-light method

Birefringent Coating: Introduction, coating stress and stains, coating sensitivity, coating materials, application of coatings, effective of coating thickness, fringe-order determinations in coatings, stress separation methods.

TEXT BOOKS:

1. Theory of elasticity / Timoshenko and Goodier Jr.
2. Experimental Stress analysis/ Dally and Riley, Mc Graw-Hill
3. Experimental Stress Analysis by James W. Dally, William Franklin Riley

REFERENCE BOOKS:

1. A treatise on Mathematical theory of elasticity / LOVE A.H./ Dover Publications
2. Photo Elasticity / Frocht/ Wiley / 3rd Edition
3. Experimental Stress Analysis: Principles and Methods By G. S. Holister

OUTCOMES:

After Completion of this course students will be able to

- Apply basic science systematization thought excavation, the evaluation, the diagnosis project question, and plans and carries out ability of the special study and the solution.
- Have independent research, collection the data, standard problem take into analytical the identification acquire conclusion, and have development innovation and compose the ability of professional thesis.
- Usage mathematics engineering realm is related analysis and design software, explanation data with independently solve the ability of problem, the project professional field self-study, the innovation ponder and ability of the sustained development.

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(R15D1516) PRESSURE VESSEL DESIGN
(ELECTIVE – III)

Objectives:

- The objective of this course is to acquire basic understanding of design Parameter.
- Complete knowledge of design procedures for commonly used process equipment and their attachments.
- This course also emphasis on the knowledge of loss prevention, personal safety, industrial safety, hazard analysis and personal proactive equipment.

UNIT–I

Introduction: Materials- shapes of Vessels –stresses in cylindrical spherical and arbitrary, shaped shells. Cylindrical Vessels subjected to internal pressure, wind load bending and torque-ilation of pressure vessels –conical and tetrahedral vessels.

Theory of Thick Cylinders: Shrink fit stresses in built up cylinders – auto freltage of thick cylinders Thermal stresses in Pressure Vessels.

UNIT–II

Theory of Rectangular Plates: Pure bending – different edge conditions.

Theory Circular Plates: Simple support and clamped ends subjected to concentrated and uniformly distributed loads-stresses from local loads. Design of dome bends, shell connections, flat heads and cone openings.

UNIT–III

Discontinuity Stresses In Pressure Vessels: Introduction beam on an elastic foundation, infinitely long beam semi infinite beam, cylindrical vessel under axially symmetrical loading, extent and significance of load deformations on pressure vessels, discontinuity stressesin vessels, stresses in a bimetallic joints, deformation and stresses in flanges.

Pressure Vessel Materials and Their Environment : Introduction ductile material tensile tests, structure and strength of steel Leuder's lines determination of stress patterns from plastic flow observations, behavior of steel beyond the yield point, effect of cold work or strain hardening on the physical properties of pressure vessel steels fracture types in tension. Toughness of materials, effect of neutron irradiation of steels, fatigue of metals, fatigue crack growth fatigue life prediction cumulative fatigue damage stress theory of failure of vessels subject to steady state and fatigue conditions.

UNIT-IV

Stress Concentrations: Influence of surface effects on fatigue, effect of the environment and other factors on fatigue life thermal stress fatigue creep and rupture of metals at elevated temperatures, hydrogen embitterment of pressure vessel steels brittle fracture effect of environment on fracture toughness, fracture toughness relationships criteria for design with defects, significance of fracture mechanics evaluations, effect of warm pre stressing on the ambient temperature toughness of pressure vessel steels.

UNIT-V

Design Features: Localized stresses and their significance, stress concentration at a variable thickness transition section in a cylindrical vessel, stress concentration about a circular hole in a plate subject to tension, elliptical openings, stress concentration, stress concentration factors for position , dynamic and thermal transient conditions, theory of reinforced openings and reinforcement, placement and shape fatigue and stress concentration.

TEXT BOOKS:

1. Theory and design of modern Pressure Vessels / John F. Harvey 'Van/ Nostrand . Reihold company / New York.
2. Pressure Vessel Design and Analysis / Bickell M. B. Ruizes / Macmillan Publishers
3. Process Equipment design / Beowll & Yound Ett.

REFERENCE BOOKS:

1. Indian standard code for unfired Pressure vessels IS 2825.
2. Pressure Vessels Design Hand Book Henry H. Bednar PE / CB S Publishers / New . Delhi.
3. Theory of plates and shells / Timoshenko& Noinosky / Dover Publications.

OUTCOMES:

- The objective of this course is to acquire basic understanding of design Parameter,.
- This course also emphasizes on the knowledge of loss prevention, personal safety, industrial safety, hazard analysis and personal proactive equipment.
- Student get the complete knowledge of design procedures for commonly used process equipment and their attachments

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L	T/P/D	C
4	0	3

(R15D1517) COMPUTATIONAL FLUID DYNAMICS (ELECTIVE – III)

Objectives:

- Study basic principles of modeling a system using software
- Study grid generation and discretization methods
- Student able know about Treatment of compressible Flows.

UNIT–I

Introduction: Finite difference method, finite volume method, finite element method, governing equations and boundary conditions, Derivation of finite difference equations.

Solution Methods: Solution methods of elliptical equations — finite difference formulations, interactive solution methods, direct method with Gaussian elimination. Parabolic equations-explicit schemes and Von Neumann stability analysis, implicit schemes,
alternating direction implicit schemes, approximate factorization, fractional step methods, direct method with tridiagonal matrix algorithm.

UNIT-II

Hyperbolic Equations: explicit schemes and Von Neumann stability analysis, implicit schemes ,multi step methods, nonlinear problems, second order one-dimensional wave equations. Burgers equations: Explicit and implicit schemes, Runge-Kutta method.

UNIT-III

Formulations of Incompressible Viscous Flows: Formulations of incompressible viscous flows by finite difference methods, pressure correction methods, vortex methods.

Treatment of Compressible Flows: potential equation, Euler equations, Navier-stokes system ofequations, flow field-dependent variation methods, boundary conditions, example problems.

UNIT-IV

Finite Volume Method: Finite volume method via finite difference method, formulations fortwo and three-dimensional problems.

UNIT-V

Standard Variational Methods: Linear fluid flow problems, steady state problems, Transient problems.

TEXT BOOKS:

1. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press,2002.
2. Text book of fluid dynamics/ Frank Choriton/ CBS Publishers & distributors, 1985
3. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publishers corporation & Mc Graw Hill.

REFERENCE BOOKS:

1. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
2. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities . Press.
3. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /Oxford University Press/2nd Edition

OUTCOMES:

- Demonstrates & explain geometrical model of a fluid flow
- Describe specific boundary conditions and solution parameters. Analyzes the results and draw the appropriate inferences.
- Student get the exposure of Finite Volume Method, Standard Variational Methods.

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4	0	3

(R15D1518) MECHATRONICS
(ELECTIVE – III)

Objectives:

- Have a strong foundation in science and focus in mechanical, electronics, control, Software and computer engineering, and a solid command of the newest technologies. Be able to design, analyze and test "intelligent" products and processes that incorporate Appropriate computing tools sensors, and actuators
- Be able to demonstrate professional interaction and communicate effectively with team Members. Be able to work efficiently in multidisciplinary teams
- Be prepared for a variety of engineering careers, graduate studies, and continuing education. Practice professional and ethical responsibility, and, be aware of the impact of their designs on human-kind and the environment.

UNIT-I

Mechatronics systems, elements, levels of Mechatronics system, Mechatronics design process, system, measurement systems, control systems, microprocessor-based controllers, advantages and disadvantages of Mechatronics systems. Sensors and transducers, types, displacement, position, proximity, velocity, motion, force, acceleration, torque, fluid pressure, liquid flow, liquid level, temperature and light sensors.

UNIT-II

Solid state electronic devices, PN junction diode, BJT, FET, DIA and TRIAC. Analog signal conditioning, amplifiers, filtering. Introduction to MEMS & typical applications.

UNIT-III

Hydraulic and pneumatic actuating systems, Fluid systems, Hydraulic and pneumatic systems components, control valves, electro-pneumatic, hydro-pneumatic, electro-hydraulic servo systems: Mechanical actuating systems and electrical actuating systems.

UNIT-IV

Digital electronics and systems, digital logic control, micro processors and micro controllers, programming, process controllers, programmable logic controllers, PLCs versus computers, application of PLCs for control.

UNIT-V

System and interfacing and data acquisition, DAQS, SCADA, A to D and D to A conversions; Dynamic models and analogies, System response. Design of Mechatronics systems & future trends.

TEXT BOOKS:

1. MECHATRONICS Integrated Mechanical Electronics Systems/KP Ramachandran & GK Vijaya Raghavan/WILEY India Edition/2008
2. Mechatronics Electronics Control Systems in Mechanical and Electrical Engineering by W Bolton, Pearson Education Press, 3rd edition, 2005.
3. Mechatronics Source Book by Newton C Braga, Thomson Publications, Chennai.

REFERENCE BOOKS:

1. Mechatronics – N. Shanmugam / Anuradha Agencies Publishers.
2. Mechatronics System Design / Devdas shetty/Richard/Thomson.
3. Mechatronics/M.D.Singh/J.G.Joshi/PHI.

OUTCOMES:

Mechatronics engineering graduates will be able to:

- Design and conduct experiments to evaluate the performance of a mechatronics system or component with respect to specifications, as well as to analyze and interpret data. Design mechatronics component, system or process to meet desired needs
- Define and solve engineering problems. Use the techniques, skills, and modern mechatronics engineering tools necessary for engineering practice. Employ the knowledge of mathematics, science, and engineering
- Function effectively as members of multidisciplinary teams. Communicate technical matters effectively in oral, written, and graphical form Identify and evaluate ethical ramifications and professional responsibilities in a variety of situations.

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4	0	3

(R15D1519) THEORY OF PLATES AND SHELLS (ELECTIVE – IV)

Objectives:

- To enable the student analyze and design thin shell structures including domes, hyperbolic, parabolic, elliptic and cylindrical shells
- To enable the student formulate Finite Element Equations for solution of the structural response of plate bending problems .
- Student able to learn about Various Edge Conditions.

UNIT-I

Bending of Long Rectangular Plates to a Cylindrical Surface: Differential equation for cylindrical bending of plates - Cylindrical bending of uniformly loaded rectangular plates with simply supported edges - Cylindrical bending of uniformly loaded rectangular plates with built-in edges

Pure Bending of Plates: Slope and curvature of slightly bent plates - Relations between bending moments and curvature in pure bending of plates - Particular cases of pure bending – Strain energy in pure bending of plates.

UNIT-II

Symmetrical Bending of Circular Plates: Differential equation for symmetrical bending of laterally loaded circular plates - Uniformly loaded circular plates - Circular plate with a circular hole at the center - Circular plate concentrically loaded - Circular plate loaded at the center.

Small Deflections of Laterally Loaded Plates: The differential equation of the deflection surface -Boundary conditions - Alternate method of derivation of the boundary condition - Reduction of the problem of bending of a plate to that of deflection of a membrane

UNIT-III

Simply Supported Rectangular Plates: Simply supported rectangular plates under sinusoidal load - Navier solution for simply supported rectangular plates.

Rectangular Plates With Various Edge Conditions: Bending of rectangular plates by moments distributed along the edges - Rectangular plates with two opposite edges simply supported and the other two edges clamped.

UNIT-IV

Continuous Rectangular Plates: Simply supported continuous plates – Approximate design of continuous plates with equal spans - Bending symmetrical with respect to a center.

Deformation of Shells Without Bending: Definition and notation - Shells in the form of a surface of revolution and loaded symmetrically with respect to their axis - Particular cases of shells in the form of surfaces of revolution - Shells of constant strength.

UNIT-V

General Theory of Cylindrical Shells: A circular cylindrical shell loaded symmetrically with respect to its axis - Particular cases of symmetrical deformation of circular cylindrical shells - Pressure vessels.

TEXT BOOKS:

1. Theory of Plates and Shells by S.TIMOSHENKO
2. Theory of Plates and Shells by S. S. Bhavikatti
3. Analysis of Plates: Theory and Problems by T. K. Varadan, K. Bhaskar

REFERENCE BOOKS:

1. Theory of Plates and Shells / Timoshenko, S. and Woinowsky -Krieger, S/McGraw . HiLL
2. Analysis of plates by David E. McFarland, Bert L. Smith, Walter D. Bernhart
3. Theory and Design of Plate Shell Structures by Maan H. Jawad

OUTCOMES:

On completing the course the student should be able to:

- Analyse and design thin shell structures including domes, hyperbolic, paraboloid, elliptic and cylindrical shells
- formulate Finite Element Equations for solution of the structural response of plate bending problems and obtain solutions to shell structures.
- Student get the exposure of different Bending conditions of Plates.

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L	T/P/D	C
4	0	3

(R15D1520) ADVANCED OPTIMIZATION TECHNIQUES AND APPLICATION (ELECTIVE – IV)

Objectives:

- To understand the formulation of a structural optimization problem, including . defining appropriate design variables, constraints, and objective functions.
- To apply various approximation methods to construct a sequence of approximate . structural design problems appropriate for static strength, natural frequencies, . buckling, and dynamic response.
- To apply appropriate algorithms for discrete design variables and multi objective optimization problems

UNIT-I

Single Variable Non-Linear Unconstrained Optimition: One dimensional Optimization methods:- Uni-modal function, elimination method, Fibonacci method, golden section method, interpolation methods- quadratic & cubic interpolation methods.

UNIT-II

Multi Variable Non-Linear Unconstrained Optimization: Direct search method –Univariant Method – pattern search methods – Powell's – Hook – Jeeves, Rosen brock search methods – gradient methods, gradient of function, steepest decent method, Fletcher reeves method. **Variable** metric method.

UNIT-III

Geometric Programming: Polynomials – arithmetic – geometric inequality – un constrained G.P – constrained G.P

Dynamic Programming: Multistage decision process, principles of optimality, examples, conversion of final problem to an initial value problem, application of dynamic programming, production inventory. Allocation, scheduling replacement.

UNIT-IV

Linear Programming: formulation – Sensivity analysis. Change in the constraints, cost coefficients, coefficients of the constraints, addition and deletion of variable, constraints. Simulation – Introduction – Types – Steps – application – inventory – queuing – thermal system.

UNIT-V

Integer Programming: Introduction – formulation – Gomory cutting plane algorithm – Zero or one algorithm, branch and bound method.

Stochastic Programming: Basic concepts of probability theory, random variables – distributions – mean, variance, Correlation, co variance, joint probability distribution – stochastic linear, dynamic programming.

TEXT BOOKS:

1. Optimization theory & Applications/ S.S Rao/ New Age International
2. ntroductory to operation research/Kasan & Kumar/Springar
3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ Narosa Publications.

REFERENCE BOOKS:

1. Operation Research/H.A. Taha/TMH
2. Optimization in operations research/R.L Rardin
3. Optimization Techniques/Benugundu & Chandraputla/Person Asia

OUTCOMES:

After Completion of this course students will be able to

- Strengthen the analytical skills of the students.
- Student get the exposure on linear programming and dynamic programming problems.
- Able to apply the optimization techniques in various applications.

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(R15D1521) MECHANICAL VIBRATIONS
(ELECTIVE – IV)

Objectives:

- Students will be able to learn how to deal with the phenomena of vibrations by . transforming the physical model into a mathematical model. Getting the response of a physical model by
- solving the mathematical model, analyzing the response and bring its physical concept.
- Analyze a system with infinite degrees of freedom and also be able to find infinite natural frequencies corresponding to infinite principle modes of the systems.

UNIT-I

Single Degree of Freedom Systems : Undamped and damped free vibrations; forced vibrations coulomb damping, Response to excitation, rotating unbalance and support excitation, vibration isolation and transmissibility- Response to Non Periodic Excitations: unit impulse, unit step and unit Ramp functions; response to arbitrary excitations, The Convolution Integral, shock spectrum, System response by the Laplace Transformation method.

UNIT-II

Two Degree Freedom Systems: Principal modes- undamped and damped free and forced vibrations, undamped vibration absorbers.

UNIT-III

Multi Degree Freedom Systems: Matrix formulation, stiffness and flexibility influence coefficients, Eigen value problem; normal modes and their properties, Free and forced vibration by Modal analysis, Method of matrix inversion, Torsional vibrations of multi- rotor systems and geared systems, Discrete- Time systems.

Vibration Measuring Instruments: Vibrometers, velocity meters & accelerometers.

UNIT-IV

Frequency Domain Vibration Analysis: Over view, machine-train monitoringparameters-Data base development-vibration data acquisition-trending analysis-failure- nodeanalysis-signature analysis-root cause analysis.

UNIT-V

Numerical Methods: Raleigh’s stodola's, Matrix iteration, Rayleigh- Ritz Method and Holzer's methods.

TEXT BOOKS:

1. Mechanical Vibrations/Groover/Nem Chand and Bros
2. Elements of Vibration Analysis by Meirovitch, TMH, 2001
3. Mechanical Vibrations/Schaum Series/ McGraw Hill

REFERENCE BOOKS:

1. Mechanical Vibrations / SS Rao/ Pearson/ 2009, Ed 4,
2. Mechanical Vibrations/Debabrata Nag/Wiley
3. Vibration problems in Engineering / S.P. Timoshenko.

OUTCOMES:

After Completion of this course students will be able to

- Understand the causes and effects of vibration in mechanical systems and their Classification.
- Solve vibration problems that contain multiple degrees of freedom and obtain design parameters. Learn how the vibration measuring instrument works and how to apply the proper instrument for a particular application.
- Apply various numerical methods to solve determinants of higher order when one deals with multi-degree freedom systems

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(R15D1522) INDUSTRIAL ROBOTICS
(OPEN ELECTIVE – II)

Objectives:

- To develop the student's knowledge in various robot structures and their workspace, and to develop student's skills in perform kinematics analysis of robot systems.
- To provide the student with some knowledge and analysis skills associated with . Trajectory planning.
- To provide the student with some knowledge and skills associated with robot control

UNIT-I

Introduction: Automation and Robotics, Robot anatomy, robot configuration, motions joint notation work volume, robot drive system, control system and dynamic performance, precision of movement.

Control System and Components: basic concept and modais controllers control systematic analysis, robot activation and feedback components. Positions sensors, velocity sensors, actuators sensors, power transmission system.

UNIT-II

Motion Analysis and Control: Manipulator kinematics, position representation forward transformation, homogeneous transformation, manipulator path control, robot dynamics, configuration of robot controller.

UNIT-III

End Effectors: Grippers-types, operation, mechanism, force analysis, tools as end effectors consideration in gripper selection and design. SENSORS: Desirable features, tactile, proximity and range sensors, uses sensors in robotics.

Machine Vision: Functions, Sensing and Digitizing-imaging, Devices, Lighting techniques, Analog to digital single conversion, image storage, Image processing and Analysis-image data reduction, Segmentation feature extraction. Object recognition, training the vision system, Robotics application.

UNIT-IV

Robot Programming: Lead through programming, Robot programming as a path in space ,Motion interpolation, WAIT, SINONAL AND DELAY commands, Branching capabilities and Limitations.

Robot Languages: Textual robot Languages, Generation, Robot language structures, Elements in function.

UNIT-V

Robot Cell desgin and control: Robot cell layouts-Robot centered cell, In-line robot cell, Considerations in work design, Work and control, Inter locks, Error detect ion, Work wheel controller.

Robot Application: Material transfer, Machine loading/unloading. Processing operation, Assembly and Inspection, Feature Application.

TEXT BOOKS:

1. Industrial Robotics / Groover M P /Pearson Edu.
2. ntroduction to Robotic Mechanics and Control / J J Craig/ Pearson / 3rd edition.
3. Robotics / Fu K S/ McGraw Hill.

REFERENCE BOOKS:

1. Robotic Engineering / Richard D. Klafter, Prentice Hall
2. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
3. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons (ASIA) Pte Ltd.

OUTCOMES:

After Completion of this course students will be able to

- Classify robots based on joints and arm configurations. Design application specific End Effectors for robots.
- Compute forward and inverse kinematics of robots and determine trajectory plan.
- Program robot to perform typical tasks including Pick and Place, Stacking and . Welding. Design and select robots for Industrial applications

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(R15D1523) COMPUTER INTEGRATED MANUFACTURING (OPEN ELECTIVE – II)

Objectives:

The students will learn to:

- Explain basic concepts of CIM systems and Develop machining programs for CNC equipment
- Develop PLC-based control systems for manufacturing cells and Design CIM systems to fulfill certain requirements
- Identify and solve problems in the operations of CIM systems and Enhance performance of manufacturing systems by applying different CIM concepts and tools

UNIT-I

Introduction: Scope of computer integrated manufacturing, Product cycle, Production automation.

Group technology: Role of group technology in CAD/CAM integration, Methods for developing part families, Classification and coding, Examples of coding systems, Facility design using group technology, Economics of group technology.

UNIT-II

Computer Aided Process Planning: Approaches to process planning - Manual, Variant, Generative approach, Process planning systems - CAPP, DCLASS, CMPP, Criteria for selecting a CAPP system, Part feature recognition, Artificial intelligence in process planning.

UNIT-III

Integrative Manufacturing Planning And Control: Role of integrative manufacturing in CAD/CAM integration, Over view of production control - Forecasting, Master production schedule, Capacity planning, M.R.P., Order release, Shop-floor control, Quality assurance, Planning and control systems, Cellular manufacturing, JIT manufacturing philosophy.

UNIT-IV

Computer Aided Quality Control: Terminology in quality control, Contact inspection methods,

Noncontact inspection methods, Computer aided testing, Integration of CAQC with AD/CAM.

UNIT-V

Computer Integrated Manufacturing Systems: Types of manufacturing systems, Machine tools and related equipment, Material handling systems, Computer control systems, FMS.

TEXT BOOKS:

1. CAD/CAM Principles and Applications by P.N. Rao, Tata McGraw Hill .Publishing. Company Ltd.
2. CAD/CAM Computer Aided Design and Manufacturing by Mikell P. Groover . and Emory W. Zimmer, Jr.
3. Computer Integrated Design and Manufacturing by David D. Bedworth, . Mark R. . Henderson, Philip M. Wolfe.

REFERENCE BOOKS:

1 Automation, Production Systems and Computer Integrated Manufacturing .by Mikell P. Groover, Prentice Hall of India Pvt. Ltd.
2 Principles of Computer Integrated Manufacturing by Vajapayee, Prentice . Hall of India Pvt. Ltd.
3 Computer Integrated Manufacturing By A. Alavudeen, N. Venkateshwaran.

OUTCOMES:

This course primarily contributes to Mechanical Engineering program outcomes:

- An ability to apply knowledge of mathematics, science, and engineering (an ability to identify, formulate, and solve engineering problems) .
- An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
- A knowledge of contemporary issues and an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

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(R15D1524) SIGNAL ANALYSIS AND CONDITION MONITORING (OPEN ELECTIVE – II)

Objectives:

Having successfully completed this module, student will be able to:

- Provide students with a sound understanding of the use of advanced instrumentation and sensing methods
- Familiarize the students with leading edge sensors research and development, introduce advanced signal processing techniques.
- provide an introduction to condition monitoring procedures system integration, apply sensors, signal processing and system design methods in condition monitoring.

UNIT-I

Introduction: Basic concepts. Fourier analysis. Bandwidth. Signal types. Convolution.

Signal Analysis: Filter response time. Detectors. Recorders. Analog analyzer types.

UNIT-II

Practical Analysis of Stationary Signals: Stepped filter analysis. Swept filter analysis. High speed analysis. Real-time analysis.

UNIT-III

Practical Analysis of Continuous Non-Stationary Signals: Choice of window type. Choice of window length. Choice of incremental step. Practical details. Scaling of the results.

UNIT-IV

Practical Analysis of Transients: Analysis as a periodic signal. Analysis by repeated playback (constant bandwidth). Analysis by repeated playback (variable bandwidth).

UNIT-V

Condition Monitoring in Real Systems: Diagnostic tools. Condition monitoring of two stage compressor. Cement mill foundation. I.D. fan. Sugar centrifugal. Cooling tower fan. Air separator. Preheater fan. Field balancing of rotors. ISO standards on vibrations.

TEXT BOOKS:

1. Condition Monitoring of Mechanical Systems / Kolacat.
2. Frequency Analysis /R.B.Randall.
3. SIGNALS AND SYSTEMS by A. ANAND KUMAR

REFERENCE BOOKS:

1. Mechanical Vibrations Practice with Basic Theory / V. Ramamurti/ Narosa Publishing House.
2. Theory of Machines and Mechanisms/ Amitabh Ghosh & AK Malik/ EWP
3. Digital Signal Processing n power system protection and control (Signals and . communication Technology) by Waldemar Rebizant , Janusz Szafran & Andrzej . Wiszniewski.

OUT COMES:

Having successfully completed this module, student will be able to:

- Design Instrumentation Systems and apply signal-processing methods understand the environmental benefits of condition monitoring techniques.
- Perform practical analysis on actual machines and systems and develop a maintenance strategy based on system response.
- Understand the advantages and limitations of a variety of techniques for condition monitoring understand the practical aspects of sensor use and type .

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-	3	2

(R15D1583) COMPUTER AIDED TESTING, ANALYSIS AND MODELING LABORATORY

Objectives:

- Model the 3-D geometric information of machine components including assemblies, and automatically generate 2-D production drawings, understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.
- Improve visualization ability of machine components and assemblies before their actual fabrication through modeling, animation, shading, rendering, lighting and coloring.
- Model complex shapes including freeform curves and surfaces.

TESTING:

1. Preparation and study of the Micro Structure of ferrous metals and alloys.
2. Preparation and study of the Microstructure of nonferrous metals and alloys.
3. Effect of tempering time on the hardness of quenched carbon steels.
4. Effect of tempering temperature on the hardness of a hardened carbon steels.
5. Preparation of metallic specimens by electro polishing.
6. Study of work hardening characteristics of a pure metal.
7. Determination of carbon percentage in the given ferrous specimen.

MODELING:

1. Surface modeling.
2. Solid modeling.
3. Drafting.
4. Assembling.

ANALYSIS OF STRUCTURES USING FEA PACKAGES:

1. Static Analysis.
2. Modal Analysis.
3. Harmonic Analysis.
4. Spectrum Analysis.
5. Buckling Analysis.
6. Analysis of Composites.
7. Fracture mechanics.
8. Transient analysis

OUTCOMES:

After Completion of this course students will be able to

- Understand the concepts of wireframe, surface and solid modeling. Develop knowledge in 2D-Transformations, 3D Transformations.
- Understand part modeling and part data exchange standards (VDA, IGES, and STEP). Understand the Assembly Modeling, Assembly tree, and Assembly Methods.
- The Students become experts on Visualization and computer animation Techniques

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-	3	2

(R15D1584) TECHNICAL SEMINAR

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L	T/P/D	C
-	3	4

(R15D1585) PROJECT SEMINAR

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M.Tech II Year – III Sem (Machine Design)

L	T/P/D	C
-	-	18

(R15D1586) PROJECT WORK

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L	T/P/D	C
-	3	22

(R15D1586) PROJECT WORK AND VIVA VOCE