CMR COLLEGE OF ENGINEERING & TECHNOLOGY
Kandlakoya(V), Medchal Road, Hyderabad
(Autonomous)

ACADEMIC REGULATIONS FOR
M. TECH. (REGULAR) DEGREE COURSE

(Applicable for the students of M. Tech. course admitted from the Academic Year 2014-15)

The M. Tech. degree 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 State Government 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.

2.5 The medium of instruction and examination shall be English.

3.0 A. Courses of Study

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

1. Bio-Technology
2. Embedded Systems
3. Power Electronics
4. Structural Engineering
5. Computer Science & Engineering
6. Machine Design

and any other course as approved by the College/ University/AICTE from time to time.

B. Departments offering M.Tech. programmes with specializations mentioned below:

Sl. No.	Department	M.Tech Course
1	Bio-Technology	Bio-Technology
2	ECE	Embedded Systems
3	EEE	Power Electronics
4	Civil	Structural Engineering
5	CSE	Computer Science & Engineering
6	Mechanical	Machine Design

4.0 Minimum Instructional Days and Attendance

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

4.1 The minimum instruction period for each semester shall be 90 clear instruction days.

4.2. A student shall be eligible to write semester end examinations if he acquires a minimum of 75% of attendance **in each of all the subjects**.

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

4.4 Shortage of attendance below 65% in aggregate shall not be condoned.

4.5 Students whose shortage of attendance is not condoned in any semester are not eligible to write their end semester examination of subjects of the corresponding semester and their registration shall stand cancelled.

4.6. A fee as prescribed by the Institute Academic Committee shall be payable towards condonation of shortage of attendance.

4.7. A candidate shall put in a minimum required attendance, in at least 50% of the theory subjects in the present semester to get promoted to the next semester. 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 will be promoted to the next semester if he satisfies the attendance requirement of the present semester including the days of attendance in sports, games, NCC and NSS activities subject to a maximum of 15 instructional days in a semester. Prior permission of the Head of the Department in writing shall be obtained by the students to avail the attendance from above mentioned activities.

5. 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 60 marks shall be awarded based on the performance in the End Semester Examination and 40 marks shall be awarded based on the Internal Evaluation. For internal evaluation there shall be two internal examinations conducted-one in the middle of the semester and the other immediately after the completion of instruction. Each internal examination shall be conducted for a total duration of 120 minutes. The final marks secured by each candidate in the internal evaluation is arrived at by giving a weightage of 70% to the best secured internal examination and 30% weightage to the least secured internal examination. A student who is absent for any internal examination for any reason what so ever shall be deemed to have secured 'zero' marks in the test/ examination and no make-up test/ examination shall be conducted.

5.1 Question paper pattern for evaluation

Internal Examination

Part A (20 Marks)

4 questions of 5 marks each (All questions are compulsory).

Part B (20 Marks)

4 questions to be answered out of 6 questions, each question carries 5 marks.

External Examination

Part A (20 Marks)

5 questions (1 question from each unit) of 4 marks each (Compulsory questions)

Part B (40 Marks)

5 questions (1 question from each unit with internal choice) each question carries 8 marks.

5.2 For practical subjects, 60 marks shall be awarded based on the performance in the End Semester Examinations. 40 marks shall be awarded in internal evaluation out of which 20 marks shall be for day to day evaluation and 20 marks shall be for internal examination.

5.3 There shall be seminar presentation during I semester as well as II semester. 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 There shall be a Comprehensive Viva-Voce in III Semester. The Comprehensive Viva-Voce will be conducted by a Committee consisting of Head of the Department and two Senior Faculty members of the Department and an external examiner. The external examiner shall be appointed by the Controller of Examinations in consultation with the HOD. The Comprehensive Viva-Voce is intended to assess the students' understanding of various subjects he has studied during the M. Tech. course of study. The Comprehensive Viva-Voce is evaluated for 100 marks by the Committee. There are no internal marks for the Comprehensive Viva-Voce. A candidate has to secure a minimum of 50% of marks to be declared successful.

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

5.6 In case the candidate does not secure the minimum academic requirement in any subject (as specified in 5.5) he has to reappear for the End semester Examination in that subject. 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 for 60 marks must be conducted with two Examiners, one of them being the Laboratory Class Teacher and the second examiner shall be appointed by the Controller of Examinations in consultation with the HOD.

6.0 Evaluation of Project / Dissertation Work:

The work on the project shall be initiated in the beginning of the III semester and the duration of the project is for two semesters. A Project Review Committee (PRC) shall be constituted comprising of Head of the Department and three other senior faculty members concerned with the M.Techprogramme. The student can initiate the Project work only after obtaining the approval of PRC. This process is to be completed within four weeks of commencement of III semester.

6.1. The candidate shall be required to submit thesis or dissertation after taking up a topic approved by the Project Review Committee.

6.2 Registration of Project Work: A candidate is permitted to register for the project work after satisfying the attendance requirement of all the previous semesters and after obtaining the approval of the Institute Academic Committee.

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 PRC for its approval.

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

6.7 Project work and Dissertation:

A candidate is permitted to submit project dissertation only after successful completion of all subjects (theory and practical), seminars, comprehensive viva-voce, and after 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 Head of the Department and shall make an oral presentation before the PRC. Along with the draft thesis the candidate shall

submit draft copy of a paper in standard format fit for publication in Journal / Conference, based on the project thesis, to the Head of the Department with due recommendation of the supervisor.

6.7.1 Four copies of the Project Dissertation certified by the Supervisor and Head of the Department shall be submitted to the College.

6.7.2 The dissertation shall be adjudicated by one examiner selected by the College. In case the thesis is found to be acceptable; viva-voce will be arranged. For this, Head of Department shall submit a panel of 3 examiners, who are eminent in that field, with the help of the PRC. The Controller of Examinations of the college in consultation with the College Academic Committee shall nominate the examiner.

6.7.3 If the report of the examiner is not favourable, the candidate shall revise and resubmit the dissertation, in the time frame as prescribed by PRC. If the report of the examiner is unfavourable again, the thesis shall be summarily rejected. The candidate can re-register only once for conduct of project and evaluation of dissertation, and will go through the entire process as mentioned above. The total duration for the M.Tech program is limited to four years.

6.7.4 If the report of the examiner is favourable, viva-voce examination shall be conducted by a Board consisting of the Head of the Department, Supervisor and the Examiner who adjudicated the Dissertation. The Board shall jointly report the student's performance in the project work as –

(a) Excellent, or
(b) Good, or
(c) Satisfactory, or
(d) Unsatisfactory,

as the case may be. In case, the student fails in the viva-voce examination, or gets the Unsatisfactory grade, he can re-appear only once for the viva-voce examination, as per the recommendations of the Board. If he fails at the second viva-voce examination, the candidate can re-register only once for conduct of project and evaluation of Dissertation, and will go through the entire process as mentioned above. The total duration for the M.Tech program is limited to four years.

7.0 Award of Degree and Class

After a student has satisfied the requirements prescribed for the completion of the program and is eligible for the award of M. Tech. Degree he shall be placed in one of the following four classes:

Class Awarded	% of marks secured
First Class with Distinction	70% and above
First Class	Below 70% but not less than 60%
Second Class	Below 60% but not less than 50%

The marks in internal evaluation and end examination shall be shown separately in the memorandum of marks.

8. Withholding of Results

If the student has not paid the dues, if any, to the institution 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. 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.

9.2 The candidate who fails in any subject will be given two chances to pass the same subject; otherwise, he has to identify an equivalent subject as per the academic regulations.

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 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 college.

MALPRACTICES RULES
DISCIPLINARY ACTION FOR IMPROPER CONDUCT IN EXAMINATIONS

	Nature of Malpractices/ Improper conduct	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/year. The Hall Ticket of the candidate is to be cancelled.
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/year. The candidate is also debarred for two consecutive semesters from class work and all end semester 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 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 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/year. The candidate is also debarred for two consecutive semesters from class work and all end semester

		Examinations. The continuation of the course by the candidate is subject to the academic regulations in connection with forfeiture of seat.
5.	Uses objectionable, abusive or offensive language in the answer paper or in letters to the examiners or writes to the examiner requesting him to award pass marks	Cancellation of the performance in that subject
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 college or organizes a walk out or instigates others **to** examination hallwalk out, or threatens the officer- in-charge or any person on duty in or outside the examination hall of any injury**,** to his person or to any of his relations whether by words, either spoken or written or by signs or by visible representation, assaults the officer- in-charge, or any person on duty in or outside the examination hall or any of his relations, or indulges in any other act of misconduct or mischief which result in damage to or destruction of property in the examination hall or any part of the College campus or engages in any other act which in the opinion of the officer on duty amounts to use of unfair means or misconduct or has the tendency to disrupt the orderly conduct of the examination.	In case of students of the college, they shall be expelled from examination halls and cancellation of their performance in that subject and all other subjects the candidate(s) has (have) already appeared and shall not be permitted to appear for the remaining examinations of the subjects of that semester/year. The candidates are also 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/year. The

		candidate is also debarred for two consecutive semesters from class work and all Semester end 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/year. 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.	If the student belongs to the college, expulsion from the examination hall and cancellation of performance in that subject that 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/year. 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 other remaining examinations of the subjects of that semester/year.
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/year.
12.	If any malpractice is detected which is not covered in the above clauses 1 to 11 shall be reported to the College Academic Committee for further action to award suitable punishment.	

Malpractices identified by squad or special invigilators

Punishments to the candidates as per the above guidelines.

Malpractice identified at Spot center during valuation

The following procedure is to be followed in case of malpractice cases detected during valuation, scrutiny etc. at spot center.

1) Malpractice is detected at the spot valuation. The case is to be referred to the malpractice committee. Malpractice committee will meet and discuss/question the candidate and based on the evidences, the committee will recommend suitable action on the candidate.
2) A notice is to be served to the candidate(s) involved through the Principal to his address and to the candidate(s) permanent address regarding the malpractice and seek explanations.
3) The involvement of staff who are in charge of conducting examinations, invigilators valuing examination papers and preparing / keeping records of documents relating to the examinations in such acts (inclusive of providing incorrect or misleading information) that infringe upon the course of natural

justice to one and all concerned at the examinations shall be viewed seriously and recommended for award of appropriate punishment after thorough enquiry.

4) Based on the explanation and recommendation of the committee, action may be initiated.

5) **Malpractice committee:**

i.	Controller of Examinations	Chairman
ii.	Assistant controller of Evaluation	Member
iii.	Chief Examiner of the subject/ subject expert	Member
iv.	Concerned Head of the Department	Member
v.	Concerned Invigilator	Member

M Tech(MACHINE DESIGN): COURSE STRUCTURE

With effect from the academic year 2014-15

I Semester					
Code	**Group**	**Subject**	**L**	P	**C**
B1601		Advanced Mechanical Engineering Design	3	0	3
B1602		Advanced Mechanics of Solids	3	0	3
B1603		Fatigue, Creep & Fracture Mechanics	3	0	3
B1604		Computational Methods in Engineering	3	0	3
B1605	Elective -I	Advanced Finite Element Analysis	3	0	3
B1606		Tribology			
B1607		Advanced Gear Engineering			
B1608		Theory of Elasticity & Plasticity			
B1609	Elective -II	Mechanics of Composite Materials	3	0	3
B1525		Data Base Management System			
B1610		Advanced Computer Aided Design			
B1611		Automation in Manufacturing			
B1612	Lab	Kinematics and Dynamics Lab	0	3	2
B1613		Seminar	0	3	2
		Total	**18**	**6**	**22**
II Semester					
Code	**Group**	**Subject**	L	P	C
B1614		Advanced Mechanics of Machinery	3	0	3
B1615		Mechanical Vibrations	3	0	3
B1616		Advanced Optimization Techniques and Applications	3	0	3
B1617		Experimental Stress Analysis	3	0	3
B1618	Elective -III	Pressure Vessel Design	3	0	3
B1619		Design Synthesis			
B1620		Non Linear Vibrations			
B1621		Robotics			
B1622	Elective -IV	Signal Analysis and Condition Monitoring	3	0	3
B1623		Advanced Mechatronics			
B1624		Computational Fluid Dynamics Techniques			
B1625		Theory of Plates and Shells			
B1626	Lab	Computer Aided Testing, Analysis andModeling Lab	0	3	2
B1627		Seminar	0	3	2
		Total	**18**	**6**	**22**

III Semester					
Code	**Group**	**Subject**	L	P	**C**
B1628		Comprehensive Viva	0	0	2
B1629		Project Seminar	0	3	2
B1630		Project Work (Continued to Next Semester)	0	0	18
		Total	**0**	**3**	**22**
IV Semester					
Code	**Group**	**Subject**	**L**	P	**C**
B1630		Project work (Continued from previous Semester)	0	0	22
		Total	**0**	**0**	**22**

(B1601)ADVANCED MECHANICAL ENGINEERING DESIGN

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

OBJECTIVES:

- To design machine components which are subjected to fluctuating loads.
- To distinguish different design criterions and their procedure to carry out the required design steps for designing mechanical components.
- To design machine components/parts based on creep criterions.
- To implement the concept of reliability for designing a machine parts or machine.

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. Material selection in machineDesign

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., Fatiguemechanisms, 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 inp value engineering, Modern approaches in design.

References:

1. Machine Design An integrated Approach/ Robert L. Norton/Prentice-Hall New Jersey, U.S.A.
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.
4. Fundamentals of Machine elements/ Hamrock, schmid and Jacobian/ 2nd Edition/ McGraw-Hill International edition.
5. Product design and development/ Kari T. Ulrich and steven D.Eppinger/ 3rd edition/ Tata McGraw Hill.
6. Product Design and Manufacturing/ A.K. Chitale and R.C. Gupta/ Prentice Hall.

Outcomes :

The student will be able to:

- To understand basic design procedures, steady and variable stresses, failure Theories.
- To study the design concepts of manufacturing processes.
- To study the design parameters by considering surface failures.
- To learn the Economic Factors Influencing Design

(B1602) ADVANCED MECHANICS OF SOLIDS

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

OBJECTIVES:

- To develop the analytical methods for solving problems in mechanics of solid those are generally considered beyond the scope of basic course in the discipline. As such, the developments tend to evolve from fundamentals principles such as equilibrium and conservation of energy.
- To understand fundamentals of linear elasticity and energy methods for solving torsion, bending problems.
- To gain a fundamental understanding of the concepts of stress and strain by analysis of solids and structures

UNIT - I

Shear Centre: Bending axis and shear center-shear center for axi-symmetric and unsymmetrical 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 loads? 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 load? 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.

References:

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
4. Theory of Plates /Timoshenko/
5. Strength of materials / Sadhu singh/ Khanna Publishers
6. Mechanics of Materials / Beer &Jhonson / McGraw Hill
7. Theory of Plates & Shells / Timoshenko/ McGraw Hill/ 2nd Edition

Outcomes :

- To understand the theory of elasticity including strain/displacement and Hooke's law relationships;
- To analyze solid mechanics problems using classical methods and energy methods;
- To solve torsion problems in bars and thin walled members;
- To solve for stresses and deflections of beams under unsymmetrical loading;
- To locate the shear center of thin wall beams;
- To obtain stresses and deflections of beams on elastic foundations;
- To obtain solutions to column buckling and plate problems;
- To apply various failure criteria for general stress states at points**.**

(B1603) FATIGUE, CREEP AND FRACUTRE MECHANICS

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives:

- To introduce students to the concepts of materials fracture and failure analysis; and
- To equip them with knowledge on how to design against catastrophic failures and skills required in carrying out failure analysis

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 topics 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 damagesummation. 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.

References:

1. Mechanical Metallurgy / Dieter / McGraw Hill
2. Fracture Mechanics: Fundamental and Applications /Anderson T.L & Boca Raton/ CRCPress, Florida, 1998.
3. Deformation and Fracture mechanics of Engineering Materials / Richard W Hertz /Wiley
4. Plasticity for structural Engineers / W.F. Chen and D.J,. Ha,
5. Engineering Fracture Mechanics/ D.R.J. Owen and A.J. Fawkes /Pincridge press,Swansea, U.K.
6. Fracture and fatigue control in structures/ S.T. Rolfe and J.M. Barsom/ Printice Hall, Eglewood cliffs, N.J..
7. Fracture of brittle solids/ B.R. Lawn and T.R. Wilshaw/ Cambridge university press.
8. Plastic deformation of Metals/ R.W.K. Honeycombe/ 2nd edition, Edward Arnold

OUTCOMES :

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

- Identify and explain the types of fractures of engineered materials and their characteristic features;
- Understand the differences in the classification of fracture mechanics (LEFM and EPFM) and how their corresponding parameters can be utilized to determine conditions under which engineering materials will be liable to fail catastrophically in service;
- Understand and explain the mechanisms of fracture; and learn how to carry out engineering failure analysis;

- appreciate the theoretical basis of the experimental techniques utilized for fracture and failure analysis(Skills)
- Develop expertise on the experimental techniques utilized for fracture and failure analysis:
- Learn simple LEFM testing methods for evaluating the fracture toughness of materials

(B1604) COMPUTATIONAL METHODS IN ENGINEERING

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives:
To learn common computational analysis methods and use them in Mechanical engineering applications.

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.

UNIT-V:

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.

References:

1. Numerical Methods for Engineers/ Steven C.Chapra, Raymond P.Canale/ Tata Mc-GrawHill
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.
4. Numerical mathematics and computing/ Ward cheney& David Kincaid / Brooks-cole publishing company 1999 fourth edition
5. Mathematical methods for physics and engineering / Riley K.F.M.P.Hobson& Bence S.J./ Cambridge university press,1999.

Outcomes :

- Understand the concept and steps of problem solving - mathematical modeling, solution and implementation.
- Learn concepts of error - identification, quantification and minimization of errors. Understand error sources of round off and truncation error. Introduce the concept of machine epsilon and significant digits, and its relation to relative errors. Reinforce these concepts in all the numerical techniques.
- Find how derivatives of functions can be calculated numerically .
- Learn methods to solve simultaneous linear equations.
- Learn methods to fit a curve to given data points via interpolation and regression.
- Learn methods to solve ordinary differential equations that are coupled and/or higher order, initial-value or boundary value problems.

(B1605) ADVANCED FINITE ELEMENT ANALYSIS
ELECTIVE – I

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives:

- To equip the students with the Finite Element Analysis fundamentals.
- To enable the students to formulate the design problems into FEA.
- To introduce basic aspects of finite element technology, including domain discretization,polynomial interpolation, application of boundary conditions, assembly of global arrays, and solution of the resulting algebraic systems.
- To introduce basic concepts of framing dynamic problems in FEA.

UNIT-I:

Introduction to FEM, basic concepts, historical back ground, applications of FEM, general description, comparison of FEM with other methods, variational approach, Galerkin's Methods. Co-ordinates, 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 : 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.

References:

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
4. Finite Element Method – Zienkiewicz / Mc Graw Hill
5. Introduction to Fininte element analysis- S.Md.Jalaludeen,Anuradha Publications, print-2012
6. A First Course in the Finite Element Method/Daryl L Logan/Cengage Learning/5th Edition
7. Finite Element Method – Krishna Murthy / TMH
8. Finite Element Analysis – Bathe / PHI

Outcomes:

The student will be able to demonstrate knowledge and understanding of:

- Fundamental concept and method of FEA
- Direct stiffness, Rayleigh-Ritz methods and FEM.
- FE formulation in solid mechanics.
- Fundamental isoparametric elements.
- FE for dynamic analysis.

(B1606) TRIBOLOGY
ELECTIVE – I

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives :

- Describe surface topography, physico-chemical aspects of solid surfaces, and surface interactions.
- Analyze the mechanics of solid elastic and elastoplastic contacts.
- Recognize the laws of friction, mechanisms of friction, friction space, stiction, stick slip, and surface temperature.
- Appreciate the various modes of wear: adhesive, delamination, fretting, abrasive, erosive, corrosive, oxidational (mild and severe), melt, and the wear-mechanism maps.
- Identify types of lubrication: boundary, solid-film, hydrodynamic, and hydrostatic lubrication.
- Examine applications/case studies: sliding contacts, rolling contacts, bearing design, coating selection, and lubrication.
- Explore the design of tribological surfaces and how to troubleshoot tribology problems.
- Survey tribological testing devices and testing design.

Unit I: Surfaces and Friction: Topography of Engineering surfaces- Contact between surfaces - Sources of sliding Friction -Adhesion Plough, Energy dissipation mechanisms, Friction Characteristics of metals - Friction of non-metals. Friction of lamellar solids - Friction of Ceramic materials and polymers, Rolling friction. Source of Rolling Friction, Stick slip motion, Measurement of Friction.

Unit II: Wear: Types of wear - Simple theory of Sliding Wear Mechanism of sliding wear of metals - Abrasive wear. Materials for Adhesive and Abrasive wear situations - Corrosive wear - Surface Fatigue wear situations - Brittle Fracture wear - Wear of Ceramics and Polymers – Wear Measurements.

Unit III: Lubricants and Lubrication Types: Types and properties of Lubricants – Testing methods - Hydrodynamic Lubrication – Elasto hydrodynamic lubrication- Boundary Lubrication - Solid Lubrication Hydrostatic Lubrication.

Unit IV: Film Lubrication Theory: Fluid film in simple shear - Viscous flow between very close parallel plates - Shear stress variation, Reynolds Equation for film Lubrication - High speed unloaded journal bearings - Loaded journal bearings - Reaction torque on the bearings –Virtual Coefficient of friction - The Somerfield diagram.

Unit V: Surface Engineering and Materials for Bearings: Surface modifications - Transformation Hardening, surface fusion - Thermo chemical processes - Surface coatings - Plating and anodizing Fusion Processes - Vapour Phase processes - Materials for rolling Element bearings - Materials for fluid film bearings - Materials for marginally lubricated and dry bearings.

References:

1. Introduction to Tribology of Bearings / Majumdar, B.C.
2. Friction. Wear, Lubrication : A Text book in Tribology / Kenneth C Ludema / CRC Press / 1st Edition
3. Engineering Tribology / John Williams / Cambridge University Press / 2005
4. Introduction to Tribology / Bharat Bhushan / Wiley / 2nd Edition
5. Engineering Tribology / Prasanta Sahoo / PHI Learning
6. Engineering Tribology / Stachowiak&Batchelor / Butterworth – Heinimann / 2005

Outcomes :

After successful completion of this Course, students will be able to

- Apply the basic theories of friction, wear and lubrication to predictions about the frictional behavior of commonly encountered sliding interfaces.
- Characterize features of rough surface and liquid lubricants as they pertain to interface sliding.
- Interpret the latest research on new topics in tribology including its application to nanoscale devices and biological systems.

(B1607) ADVANCED GEAR ENGINEERING
(PSG Design data Book is allowed)
ELECTIVE – I

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives :

This course is intended to give a basic understanding of gear geometry and design procedures. A brief introduction to manufacture is included, as is metrology and tolerance.

UNIT – I
Introduction : Fundamental, advanced and current research scenario of materials, design, manufacturing and performance aspects of gears including gear metrology

UNIT – II

Gear Materials and Surface Treatment: Recent and potential gear materials including polymer and metal matrix composite materials. Surface treatment including conventional and non conventional methods.

UNIT – III

Gear Design: Design fundamental including corrected gears. Design code including AGMA procedure, direct gear design, non standard gears. Role of finite element method for strength and transmission error prediction. Design of die including gate design for molding simulation of polymer based gears.

UNIT – IV
Gear Manufacturing: Precision gear manufacturing through non conventional manufacturing process including ECH, EDM, micro WEDM. Injection moulding, micro injection moulding, sintering for polymer and metal matrix composite gear manufacturing

UNIT – V
Gear Performance: Testing procedure including power circulating, power absorption gear test rig for durability evaluation. Single tooth bending load carrying capability, rolling contact fatigue test rig. Kinematic performance analysis including transmission error evaluation test rig. Condition monitoring of gears including fault diagnostic methods. Gear measuring center-individual and composite error

Text Book:
Advanced Gear Engineering, Goldfarb, Veniamin, Trubachev, Evgenii, Barmina, Natalya

References:

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/ DarleW.Dudley/ McGraw-Hill book company.
4 Analytical mechanics of gears/ Earle Buckingham/ Dover publications, New York, 1949.
5 Hand book of gear design/ G.M.Maitha / Tata McGraw Hill publishing company Ltd, NewDelhi, 1994.
6. Machine Design / Shaum series / McGraw Hill

Outcomes :

The student will be able to:

- Design various types of gears
- Analyse tooth forces.
- Design optimal gear.

(B1608) THEORY OF ELASTICITY AND PLASTICITY
ELECTIVE – I

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives:

- To study the classical theory of linear elasticity for two and three dimensional state of stress and obtain solutions for selected problems in rectangular and polar coordinates as well as torsion of prismatic bars .
- To understand the plastic stress strain relations, criteria of yielding and elasto-plastic problems

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.

References:

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
4. Theory of Plasticity for Engineers/Hoffman and Sacks/TMH
5. Theory of Elasticity and Plasticity/Sadhu Singh/ Khanna Publishers
6. Theory of Elasticity and Plasticity/Harold Malcolm Westergaard/Harvard University Press

Outcomes :

The student will be able to

- To learn stress strain relationship for plain stress and strain problems
- To learn to solve 2d problems using different techniques
- To learn the application of complex variables in elasticity problems
- To learn yield criteria

(B1609) MECHANICS OF COMPOSITE MATERIALS
ELECTIVE – II

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives: The objective for this course is to develop an understanding of the linear elastic analysis of composite materials. This understanding will include concepts such as anisotropic material behavior and the analysis of laminated plates.

UNIT - I

Introduction to Composite Materials: Introduction, classification, polymer matrix composites, metal matrix composites, ceramic matrix composites, carbon-carbon composites,
fiber, reinforced composites and nature-made composites and applications.

Reinforcements: Fibers Glass, Silica, Kevlar, carbon, boron, silicon carbide, and born carbide, fibres. Particulate composites, Polymer composites, Thermoplastics, Thermosetts, Metal matrix and ceramic composites.

UNIT – II

Manufacturing Methods: Autoclave, tape production, moulding methods, filament winding, man layup, pultrusion, RTM. Macro mechanical Analysis of a "Lamina": introduction,

Definitions: stress, strain, Elastic Moduli, strain Energy. Hooke's Law for different types of materials, Hooks Law for a two dimensional unidirectional lamina, plane stress assumption,
reduction of Hooks Law in three dimensions to two dimensions, relationship of compliance
and stiffness matrix to engineering elastic constants of a lamina.

UNIT – III

Hooke’s Law for a Two-Dimensional Angle Lamina, Engineering constants of an Angle Lamina. Invariant Form of Stiffness and compliance Matrices for an Angle Lamina Strength Failure. Envelops, Maximum Strain Failure Theory, Tsai-Hill Failure Theory, Tsai-Wu Failure Theory Comparison of Experimental Results with Failure Theories.

Hygrothermal Stresses and Strains in a Lamina: Hygrothermal Stress-Strain Relationships for a Unidirectional Lamina, Hygrothermal Stress-Strain Relationships for a Angle Lamina.

UNIT - IV

Micromechanical Analysis of A Lamina: Introduction, Volume and Mass Fractions, Density, and Void Content, Evaluation of the Four Elastic Moduli, Strength of Materials Approach, Semi Empirical Models Elasticity Approach, Elastic Moduli of Lamina with Transversely Isotropic Fibers, Ultimate Strengths of a Unidirectional Lamina, Coefficients of
Thermal Expansion, Coefficients of Moisture Expansion .

UNIT - V

Macro mechanical Analysis of Laminates: Introduction, Laminate Code, Stress-Strain Relations for a Laminate, In-Plane and Flexural Modules of a Laminate, Hygrothermal Effects in a Laminate, Warpage of Laminates.

Failure Analysis and Design of Laminates: Introduction Special Cases of Laminates, Failure Criterion for a Laminate, Design of a Laminated Composite, Other Mechanical Design Issues

References:

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.
4. Mechanics of Composite Materials/ Second Edition (Mechanical Engineering)/ Autar K. Kaw ,**Publisher:** CRC
5. Analysis of Laminated Composite Structures/ L. R. Calcote/ Van Nostrand Rainfold, New York, 1969.
6. Advanced Mechanics of Composite Materials/ Vasiliev&Morozov/Elsevier/Second Edition

Outcomes:

Students who successfully complete the course will demonstrate the following outcomes

- 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.
- 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.

(B1525) DATA BASE MANAGEMENT SYSTEM
ELECTIVE – II

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives:

1. To educate students with fundamental concepts of data base management system,data model,different data base languages.
2.To analyze data base design methodology.
3. To know OLTP,OLAP and some advanced topics in DBMS.

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.

References:

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
4. Introduction to Database Management Systems / C.J.Date/ Pearson Education
5. Database Systems design, Implemantation and Management/ Rob & Coronel/ 5th Edition,Thomson.
6. Database Management Systems/ ElmasriNavrate/ Pearson Education.
7. Database Management Systems /Mathew Leon, Leon Vikas/
8. Database Systems / Connoley/ Pearson Education.

Outcomes :
The student will be able to

- Acquire knowledge in fundamentals of data base management system.

- be able to analyze the difference between traditional file system and DBMS.
- able to handle difference data base languages.
- Draw various data models for data base.

(B1610) ADVANCED COMPUTER AIDED DESIGN
ELECTIVE – II

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives:

- To understand the basic analytical fundamentals that are used to create and manipulate geometric models in a computer program.
- To model complex shapes including freeform curves and surfaces.
- To understand various graphics standard for CAD data exchange (such as IGES, PARA etc).

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 of CAD, Modeling and viewing, software documentation, efficient use of CAD software.

Geometricmodelling: Types of mathematical representation of curves, wire frame models wire frame entities parametric representation of synthetic curves hermite cubic splines Bezier curves 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.

References :

1. Mastering CAD/CAM / IbrhimZeid / Mc Graw Hill International.
2. CAD/CAM Principles and Applications/ P.N.Rao/TMH/3rd Edition
3. CAD/CAM /Groover M.P./ Pearson education
4. CAD/CAM Concepts and Applications/ Alavala/ PHI
5. CAD / CAM / CIM, Radhakrishnan and Subramanian/ New Age
6. Principles of Computer Aided Design and Manufacturing/ Farid Amirouche/ Pearson
7. Computer Numerical Control Concepts and programming/ Warren S Seames/ Thomson.

Outcomes :
The student will be able to

- Develop an understanding of the advanced aspects of enabling computer aided technologies used in design, manufacturing and rapid product development.
- Develop a degree of competency in the development and application of modern CAD/CAM system through hands on experience in the solution of practical problems

(B1611) AUTOMATION IN MANUFACTURING
ELECTIVE – II

L	P	C
3	0	3

M.Tech.(Machine Design) I Semester

Objectives :

To understand basic issues in product design, manufacturing system design, work station design.

Unit-I

Introduction: Why automation in manufacturing, Current trends, CAD, CAM, CIM; Rigid automation: Part handling, Machine tools.

Computer Aided Design: Fundamentals of CAD - Hardware in CAD-Computer Graphic Software and Data Base, Geometric modeling for downstream applications and analysis methods; Computer Aided Manufacturing: CNC technology, PLC, Micro-controllers, CNC Adaptive Control

Unit-II

Introduction: Types and strategies of automation, pneumatic and hydraulic components, circuits, automation in machine tools, mechanical feeding and tool changing and machine tool control.

Flexible automation: Computer Control of Machine Tools and Machining Centers, NC and NC part programming, CNC-Adaptive Control, Automated Material handling. Assembly, Flexible fixturing.

UNIT III :

Automated flow lines: Methods of part transport, transfer mechanism, buffer storage, control function, design and fabrication considerations. Analysis of automated flow lines – General terminology and analysis of transfer lines without and with buffer storage, partial automation, implementation of automated flow lines.

Assembly System And Line Balancing: Assembly process and systems, assembly line, line balancing methods, ways of improving line balance, flexible assembly lines.

UNIT – IV :

Automated Material Handling And Storage Systems:

Types of equipment, functions, analysis and design of material handling systems, conveyor systems, automated guided vehicle systems. Automated storage and retrieval systems; work in process storage, interfacing handling and storage with manufacturing.

UNIT – V :

Adaptive Control Systems: Introduction, adaptive control with optimization, adaptive control with constraints, application of adaptive control in machining operations.

Consideration of various parameters such as cutting force, temperatures, vibration and acoustic emission in the adaptive controls systems.

Automated Inspection: Fundamentals, types of inspection methods and equipment, Coordinate Measuring Machines, Machine Vision.

TEXT BOOK

- Automation, Production Systems and Computer Integrated Manufacturing : M.P. Groover./ PE/PHI.

REFERENCES

- Computer Control of Manufacturing Systems by Yoram Coren.
- CAD / CAM/ CIM by Radhakrishnan.
- Automation by W. Buekinsham.

Course outcomes

Upon successful completion of this course student should be able to :

1. Solve the line balancing problems in the various flow line systems with and without use buffer storage.
2. Understand the different automated material handling, storage and retrieval systems and automated inspection systems.
3. Use of Adaptive Control principles and implement the same online inspection and control.

- **(B1612) KINEMATICS AND DYNAMICS LABORATORY**

L	P	C
0	3	2

M.Tech.(Machine Design) I Semester

Objectives :

- To supplement the principles learnt in kinematics and dynamics of machinery
- To understand how certain measuring devices are used for dynamic testing.

(A Minimum of 10 experiments are to be conducted)

Experiments:

1. Determination of damped natural frequency of vibration of the vibrating system withdifferent 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 andrepresentation of vectors.
7. Determination of natural frequency of given structure using FFT analyzer.
8. Diagnosis of a machine using FFT analyzer.
9. Direct Kinematic analysis of a robot.
10. Inverse Kinematic analysis of a robot.
11. Trajectory planning of a robot in joint space scheme.
12. Palletizing operation using Robot programming.

Outcomes :

The student will be able to

- Determine natural frequencies of free and forced vibrations.
- Balance the masses in mechanisms.
- Analyse using FFT analyzer.

(B1614) ADVANCED MECHANICS OF MACHINERY

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objectives:

- To understand the basic concepts of robot manipulator for design as well as analysis purpose.
- To be aware about mathematical approach to make some renovation in robotics field.
- This course treats the conceptual design of mechanisms.
- This enables the student to recognize problem areas, generate design alternatives and make the appropriate choices.
- The course provides thorough understanding into important principles for mechanism design, including:
- Designing for light and stiff mechanisms, exact kinematic constraint design, design of low-hysteresis mechanisms and designing manipulators.

UNIT – I

Advanced Kinematics of Plane Motion- I: Introduction to plane motion. The Inflection circle, Euler – Savary Equation, Analytical and graphical determination of d_i ,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 a four bar mechanism.

UNIT – III

Introduction to Synthesis-Graphical Methods - I: The Four bar linkage ,Guiding abodythrough 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.

Reference:

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.
4. Kinematics and Linkage Design/ Allen S.Hall Jr./ PHI,1964.
5. Kinematics and Dynamics of Machinery/Charles E Wilson/Pearson/3rd Edition

Outcomes :

The student will be able

- To determine about forces acting on various parts of mechanisms.
- To learn static and dynamic balancing of masses.
- To analyze various types of synthesis-graphical methods.
- To analyze various types of synthesis-analytical methods.

(B1615) MECHANICAL VIBRATIONS

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objective: To study the characteristics of free and forced vibrations.

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 monitoring parameters-Data base development-vibration data acquisition-trending analysis-failure-node analysis-signature analysis-root cause analysis.

UNIT V:

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

References:

1. Mechanical Vibrations/Groover/Nem Chand and Bros
2. Elements of Vibration Analysis by Meirovitch, TMH, 2001
3. Mechanical Vibrations/Schaum Series/ McGraw Hill
4. Mechanical Vibrations / SS Rao/ Pearson/ 2009, Ed 4,
5. Mechanical Vibrations/Debabrata Nag/Wiley
6. Vibration problems in Engineering / S.P. Timoshenko.

7. Mechanical Vibrations and sound engineering/ A.G.Ambekar/ PHI
8. Theory and Practice of Mechanical Vibrations/JS Rao & K. Gupta/New Age Intl.Publishers/Revised 2nd Edition

Outcomes :

The student will be able to

- To understand the various types of vibration and analyses.
- To understand the various vibration control techniques.

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(B1616) ADVANCED OPTIMIZATION TECHNIQUES AND APPLICATION

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objective:

- To equip the students with the Engineering Optimization fundamentals.
- To enable the students to formulate the optimization problems into FEA.
- The course aims at integrating traditional design methodologies with concepts and techniques of modern optimization theory and practice. In the course the student will learn to create an appropriate mathematical description (a simulation model) of the design problem.
- To formulate the optimization problem and finally to use numerical optimization techniques and computer support tools in order to solve the problem.

UNIT- I

Single Variable Non-Linear Unconstrained Optimization: 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, Rosenbrock search methods – gradient methods, gradient of function, steepest decent method, Fletcher reeves method. Variable metric method.

UNIT - III

Geometric Programming: Polynomials – arithmetic – geometric inequality – unconstrained 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.

References:

1. Optimization theory & Applications/ S.S Rao/ New Age International
2. Introductory to operation research/Kasan& Kumar/Springar
3. Optimization Techniques theory and practice / M.C Joshi, K.M Moudgalya/ NarosaPublications.
4. Operation Research/H.A. Taha/TMH
5. Optimization in operations research/R.LRardin
6. Optimization Techniques/Benugundu&Chandraputla/Person Asia

Outcomes :

- To introduce the various optimization techniques and their advancements.
- To make use of the above techniques while modeling and solving the engineering problems of different fields.

(B1617) EXPERIMENTAL STRESS ANALYSIS

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objectives :

1. To understand the relation between the mechanics theory and experimental stress analysis.
2. To establish the fundamental concepts and newly experimental techniques.
3. To be able to use the experimental techniques on practical problems.

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 ofplane 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, effectivestresses, the shear-difference method in three dimensions, applications of the Frozen-stressmethod, 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.

References:

1. Theory of elasticity / Timoshenko and Goodier Jr.
2. Experimental Stress analysis/ Dally and Riley, Mc Graw-Hill
3. A treatise on Mathematical theory of elasticity / LOVE A.H./ Dover Publications
4. Photo Elasticity / Frocht/ Wiley / 3rd Edition
5. Experimental Stress Analysis / Sadhu singh / Khanna Publications.

OUTCOMES :

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

- Know about strain measurement methods.
- Get concepts on brittle coatings and moiré methods.
- Get knowledge on photo elasticity

(B1618) PRESSURE VESSEL DESIGN
ELECTIVE – III

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objectives:

- To Describe the background of the Code
- To Explain how to apply the Code rules to more common design and fabrication situations
- To Identify the calculations for some of the loadings and situations not addressed by the Code
- To Describe the preparation of design specifications, design reports, data reports, and other to documentation

UNIT – I

Introduction, Materials- shapes of Vessels –stresses in cylindrical spherical and arbitrary, shapedshells. 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 stresses in 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 lifeprediction cumulative fatigue damage stress theory of failure of vessels subject to steady stateand 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 prestressing 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.

References:

1. Theory and design of modern Pressure Vessels / John F. Harvey 'Van/ Nostrand Reiholdcompany / New York.
2. Pressure Vessel Design and Analysis / Bickell M. B. Ruizes / Macmillan Publishers
3. Process Equipment design / Beowll&YoundEtt.
4. Indian standard code for unfired Pressure vessels IS 2825.
5. Pressure Vessels Design Hand Book Henry H. Bednar PE / CB S Publishers / NewDelhi.
6. Theory of plates and shells / Timoshenko&Noinosky / Dover Publications.
7. Stress in Beams, Plates and Shells / Ansel C. Ugural / CRC Press / 3rd Edition.

Outcomes ;

- Knowledge of basics of process equipment design and important parameters of equipment design
- Ability to design internal pressure vessels and external pressure vessels
- Ability to design special vessels (e.g. tall vessels) and various parts of vessels (e.g. heads)
- Knowledge of equipment fabrication and testing methods

(B1619)DESIGN SYNTHESIS
ELECTIVE – III

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objectives:

- Understand modern manufacturing operations, including their capabilities, limitations,
- Learn how to analyze products and be able to improve their manufacturability and lower costs.
- Be able to examine a product and determine how it was manufactured and why.
- Understand how and why value stream analysis is used to lower manufacturing costs.
- Understand the advantages and disadvantages of hard (inflexible) and soft (flexible) manufacturing automation.

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.

References:

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. Mechanical Design Theory Methodology/ Manjula B. Waldron and Kenneth J. Waldron/
Springer Verlag New York 1996.

Outcomes:

After studying this course ,the student will be able to

- Design process and methodologies of systematic design .
- Design metal parts for various mechanical processes.
- Design for assembly and dismantling .
- Formulate Problems for design optimization

(B1620) NON LINEAR VIBRATIONS
ELECTIVE – III

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objectives:
To provide a background for solving vibration problems related to machinery using analytical and numerical methods, and a solid foundation for advanced studies in dynamics and vibrations.

UNIT - I
Undamped Free Vibrations :- Introduction Geometric Non linearity, Material or Power-law type of nonlinearity, Elliptic function approach, A-priori synthesis of nonlinear differential equations, Frequency calculation, Approximate methods, Perturbation method, Qualitative aspects of motion Phase- Plane techniques, Graphical techniques, Averaging method based on residuals.

UNIT- II
Damped Free Vibrations:- Introduction Motion with viscous damping, Quadratic (square-law) damping, Nonlinear system with variable damping, Damped free oscillators-Geometry of integralcurves, Method of Averaging.

UNIT - III
Forced Vibrations: - Introduction Undamped nonlinear oscillator subject to harmonic excitation, Approximate method: Elliptic cosine-type excitation, Perturbation method, Iteration method: Undamped Duffing's equation, Discontinuous jump in amplitude as force varies in the equation ($x+\alpha x+\beta x^3=F \cos \omega t$), Stability of fundamental solution for Duffing's equation, Duffing's equation: Sub-Harmonics, Stability criteria for sub-harmonic of order 1/3.

UNIT -IV
Damped Forced vibrations: - Equivalent viscous damping, Variational methods, The method of slowly-varying parameters, Method of harmonic balance, Duffing's equation with viscous damping, Iteration method for undamped Duffing's equation , 1/3rd order sub-harmonics in Duffing's equation with viscous damping.

UNIT - V
Transient Analysis of Nonlinear (Neoconservative Systems) Introduction-Step response, The Equation of Motion and method of solution, Pulse response of nonlinear systems, Pulse responseof Duffing's oscillator.

References:

1. Nonlinear Mechanical Vibrations / P.Srinivasan/,New age international publications.
2. Elements of vibration Analysis/ Leonard Meirovitch./ 2nd Edition / McGrawHill.
3. Mechanical vibrations/ Francis TSC, Ivan , Rolland T. Hinkle/ 2nd Edition/ CBSpublications
4. Theory and Problems of Mechanical Vibrations/ William W. SETO /Schaums out lineseries/ McGrawHill.

Outcomes:

A student who has met the objectives of the course will be able to:

- Identify sources for inertia, stiffness, energy-dissipation and external loads in some standard mechanical systems.
- Identify the relevant degrees of freedom in simple models of mechanical systems.
- Use Newton's second law and free body diagrams to determine the equations of motion for simple models of mechanical systems with a finite or infinite number of degrees of freedom.
- Use Lagrange's equations and the flexibility and stiffness methods to determine the equations of motion for simple models of mechanical systems with a finite or infinite number of degrees of freedom.
- Rewrite equations of motion for specific models into the standard form of ordinary differential equations (scalar or matrix-vector form).
- Use mathematical and numerical methods to solve standard equations of motion for mechanical system models.
- Give applicable interpretations and evaluations of analytical and numerical results.
- Identify resonance problems for mechanical systems whose dynamics (i.e. inertia and energy dissipation) can not be neglected.

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(B1621) ROBOTICS
ELECTIVE – III

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objectives:

- To be familiar with the automation and brief history of robot and applications.
- To give the student familiarities with the kinematics of robots.
- To give knowledge about robot end effectors and their design.
- To learn about Robot Programming methods & Languages of robot.
- To give knowledge about various Sensors and their applications in robots.

Unit – I

Introduction: Automation and Robotics - an over view of Robotics -classification by coordinate system and control systems - Components of the Industrial Robotics: Degrees of freedom - End effectors: Mechanical gripper - Magnetic - Vacuum cup and other types of grippers - General consideration on gripper selection and design, Robot actuator and sensors.

Unit - II

Motion Analysis: Basic rotation matrices - Composite rotation matrices - Euler Angles - Equivalent Angle and Axis - Homogeneous transformation -Problems. Manipulator Kinematics: D-H notations - Joint coordinates and world coordinates - Forward and inverse kinematics - problems.

Unit - III

Differential Kinematics: Differential Kinematics of planar and spherical manipulators - Jacobians - problems. Robot Dynamics: Lagrange - Euler formulations - Newton-Euler formulations - Problems on planar two link manipulators.

Unit -IV

Trajectory Planning: Joint space scheme - cubic polynomial fit -Avoidance of obstacles - Types of motion: Slew motion - joint interpolated motion -straight line motion - problems**.**

Robot actuators and Feedback components: Actuators: Pneumatic.

Unit –V

Robot Application in Manufacturing: Material handling - Assembly and Inspection - Work cell design, work volume, Robot screan.

References:

1. Industrial Robotics / Groover M P /Pearson Edu.

2. Introduction to Robotic Mechanics and Control / J J Craig/ Pearson / 3rd edition.
3. Robotics / Fu K S/ McGraw Hill.
4. Robotic Engineering / Richard D. Klafter, Prentice Hall
5. Robot Analysis and Intelligence / Asada and Slotine / Wiley Inter-Science.
6. Robot Dynamics & Control – Mark W. Spong and M. Vidyasagar / John Wiley & Sons
(ASIA) Pte Ltd.
1. Robotics and Control / Mittal R K &Nagrath I J / TMH.

OUTCOMES:

- Students will be equipped with the automation and brief history of robot and applications.
- Students will be familiarized with the kinematic motions of robot.
- Students will have good knowledge about robot end effectors and their design concepts.
- Students will be equipped with the Programming methods & various Languages of robots.
- Students will be equipped with the principles of various Sensors and theirapplicationsinrobots.

(B1622) SIGNAL ANALYSIS AND CONDITION MONITORING
ELECTIVE – IV

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objectives:

This course aims to:

1. provide students with a sound understanding of the use of advanced instrumentation and sensing method
2. familiarise the students with leading edge sensors research and development
3. introduce advanced signal processing techniques
4. provide an introduction to condition monitoring procedures and system integration
5. 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.

References:

1. Condition Monitoring of Mechanical Systems / Kolacat.
2. Frequency Analysis /R.B.Randall.
3. Mechanical Vibrations Practice with Basic Theory / V. Ramamurti/ Narosa PublishingHouse.
4. Theory of Machines and Mechanisms/ Amitabh Ghosh & AK Malik/ EWP

OUTCOMES :

Having successfully completed the course, the student will be able to demonstrate knowledge and understanding of:

- the principles of instrumentation and measurement systems .
- the transducers typically encountered in engineering applications .
- condition monitoring approaches, sensor types, sensor placement, data analysis .

(B1623) ADVANCED MECHATRONICS
ELECTIVE – IV

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objective:

1. To study about basic electronic components and to design circuits for mechanical applications.
2. To study about sensors and transducers and their significant applications in mechanical engineering applications.
3. To study about the microprocessor and microcontroller architecture and its important applications in machineries and automotives.
4. To study about programmable logic controller and to develop applications for mechanical systems.
5. To study designing of Mechatronic systems for automotive, electronic appliances etc.

UNIT – I

Introduction: Definition – Trends - Control Methods: Standalone , PC Based (Real Time Operating Systems, Graphical User Interface , Simulation) - Applications: identification of sensors and actuators in Washing machine, Automatic Camera, Engine Management, SPM,
Robot, CNC, FMS, CIM.

Signal Conditioning : Introduction – Hardware - Digital I/O , Analog input – ADC , resolution, Filtering Noise using passive components – Registors, capacitors - Amplifying
signals using OP amps –Software - Digital Signal Processing – Low pass , high pass , notch
filtering

UNIT – II

Precision Mechanical Systems : Modern CNC Machines – Design aspects in machine structures, guideways, feed drives, spindle and spindle bearings, measuring systems, control
software and operator interface, gauging and tool monitoring.

Electronic Interface Subsystems :TTL, CMOS interfacing - Sensor interfacing – Actuator
interfacing – solenoids , motors Isolation schemes- opto coupling, buffer IC's - Protection schemes – circuit breakers , over current sensing , resetable fuses , thermal dissipation - Power Supply - Bipolar transistors / mosfets

UNIT – III

Electromechanical Drives : Relays and Solenoids - Stepper Motors - DC brushed motors –
DC brushless motors - DC servo motors - 4-quadrant servo drives , PWM's - Pulse Width Modulation – Variable Frequency Drives, Vector Drives - Drive System load calculation.

Microcontrollers Overview : 8051 Microcontroller , micro processor structure – Digital Interfacing - Analog Interfacing - Digital to Analog Convertors - Analog to Digital Convertors - Applications. Programming –Assembly, C (LED Blinking , Voltage measurement using ADC).

UNIT – IV
Programmable Logic Controllers : Basic Structure - Programming : Ladder diagram - Timers,
Internal Relays and Counters - Shift Registers - Master and Jump Controls - Data Handling -
Analog input / output - PLC Selection - Application.

UNIT – V
Programmable Motion Controllers : Introduction - System Transfer Function – Laplace
transform and its application in analysing differential equation of a control system - Feedback
Devices : Position , Velocity Sensors - Optical Incremental encoders - Proximity Sensors :
Inductive , Capacitive , Infrared - Continuous and discrete processes - Control System Performance & tuning - Digital Controllers - P , PI , PID Control - Control modes – Position ,
Velocity and Torque - Velocity Profiles – Trapezoidal- S. Curve - Electronic Gearing - Controlled Velocity Profile - Multi axis Interpolation , PTP , Linear , Circular - Core functionalities – Home , Record position , GOTO Position - Applications : SPM, Robotics.

References:

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

5. Mechatronics System Design / Devdasshetty/Richard/Thomson.
6. Mechatronics/M.D.Singh/J.G.Joshi/PHI.
7. Mechatronics – Electronic Control Systems in Mechanical and Electrical Engg. 4th Edition, Pearson, 2012 W. Bolton
8. Mechatronics – Principles and Application Godfrey C. Onwubolu, Elsevier, 2006Indian print

Outcomes:

On successful completion of this module the Student will be able to

- Summerise how mechatronics integrates knowledge from different disciplines in order to realise engineering and consumer products that are useful in everyday life.
- Design static and dynamic boolean logic systems using Combinational, synchronous and asynchronous sequential logic.
- Outline the operation of the fundamental elements of microprocessor systems.
- Select appropriate transducer signal conditioning and devices for data conversion including operational amplifiers for analogue signal processing.
- Implement a continuous-time control design using software on a microprocessor for the Manipulation, Transmission, and Recording of Data.
- Select suitable actuators and sensors and integrate them with embedded control computers.

(B1624) COMPUTATIONAL FLUID DYNAMICS TECHNIQUES ELECTIVE – IV

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objectives:

1. To understand the basics of governing equations and boundary conditions
2. To gain knowledge about finite difference method
3. To enable student to learn about FVM – Diffusion.
4. To gain knowledge about FVM-Convection diffusion.
5. To elaborate about FVM flow field calculation

Unit – I

Methods to solve a physical problem-Numerical Methods-Brief comparison between FDM, FEM & FVM-Applied Numerical Methods: Solution of a system of simultaneous Linear Algebraic Equations, iterative schemes of Matrix Inversion, Direct Methods for Matrix inversion, Direct Methods for banded matrices. Finite Difference Applications in Heat conduction and Convention – Heat conduction, steady heat conduction in a rectangular geometry, transient heat conduction, finite difference application in convective heat transfer, closure.

Unit - II

Finite Differences, discretization, consistency, stability, and Fundamentals of fluid flow modeling: Introduction, elementary finite difference quotients, implementation aspects of finite-difference equations, consistency, explicit and implicit methods

Unit - III

Errors and stability analysis, introduction, first order wave equation, stability of hyperbolic and elliptic equations, fundamentals of fluid flow modeling, conservative property, the upwind scheme. Review of Equations Governing Fluid Flow and Heat Transfer: Introduction, conservation of mass Newton‘s second law of motion, expanded forms of Navier-stokes equations, conservation of energy principle and special forms of the Navier-stokes equations.

Unit - IV

Steady flow, dimensionless form of Momentum and Energy equations, Stokes equation, and conservative body force fields, stream function- Vorticity formulation, Boundary-layer theory, Buoyancy – Driven Convection and stability.

Unit – V

Simple CFD Techniques, viscous flows conservation form space marching, relovation techniques, viscous flows, conservation from space marching relovation techniques,

artificial viscosity, the alternating direction implicit techniques, pressure correction technique, computer graphic techniques used in CFD Quasi one dimensional flow through a nozzle, turbulence models, standard and high Reynolds number models and their applications

References:

1. Computational fluid dynamics/ T. J.C'hung/ Cambridge University press,2002.
2. Text book of fluid dynamics/ FrankChoriton/ CBS Publishers & distributors, 1985
3. Numerical heat transfer and fluid flow / Suhas V. Patankar/ Hema shava Publisherscorporation & Mc Graw Hill.
4. Computational Fluid Flow and Heat Transfer/ Muralidaran/ Narosa Publications
5. Computational Fluid Dynamics: Basics with applications/John D. Anderson/ Mc Graw Hill.
6. Fundamentals of Computational Fluid Dynamics/Tapan K. Sengupta / Universities Press.
7. Introduction to Theoretical and Computational Fluid Dynamics/C. Pozrikidis /OxfordUniversity Press/2nd Edition.

Outcomes :

The student will be able to

- Solve solution equations.
- Solve Hyperbolic equations
- Formulate Incompressible Viscous Flows
- Formulate 2D& 3D problems using Finite Volume Method & Standard Variational Methods

(B1625) THEORY OF PLATES AND SHELLS
ELECTIVE – IV

L	P	C
3	0	3

M.Tech.(Machine Design) II Semester

Objectives:

1. Introduce students to the classical structural mechanics approximations of Membrane, Plate and Shell theories.
2. Use energy formulations to demonstrate the consistent derivation of approximate boundary conditions and edge effects.
3. Demonstrate the analysis tools necessary to describe static, dynamic and non-linear motions.
4. Demonstrate the approximation of the classical formulations using numerical approximation techniques.

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 acircular 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 theproblem 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 surfaceof revolution and loaded symmetrically with respect to their axis - Particular cases of shells in theform 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.

References:

1. Theory of Plates and Shells / Timoshenko, S. and Woinowsky-Krieger, S/McGraw Hill
2. Stress in Beams, Plates and Shells / Ansel C. Ugural / CRC Press / 3rd Edition.

Outcomes:
students can:

- Apply the structural mechanics approximations of membrane, plates and shells.
- Derive simple modifications to the membrane plate and shell theories.
- Use analysis to determine the static, dynamic, and non-linear motion of membrane, plate ad shell structures.
- Compute numerical approximations.

(B1626) COMPUTER AIDED TESTING, ANALYSIS AND MODELING LABORATORY

L	P	C
0	3	2

M.Tech.(Machine Design) II Semester

Objectives:

- To Know microstructure of metals and alloys
- To know about modeling,drafting and assembling.
- To know about analysis of structures

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:

The student will be able to

- To prepare and study microstructure of metals and alloys
- To do modeling ,drafting and assembling.
- To analyze structures using FEA packages