SIR PADAMPAT SINGHANIA UNIVERSITY

Course Structure & Detailed Syllabus

Master of Technology

in

MECHANICAL ENGINEERING

Specialization

in

MACHINE DESIGN

(With Effect from Batch of 2021-2023)

OVERVIEW

This syllabus is designed under CBCS framework. Students will have good number of choices of courses through electives to hone their skills in their specialization field. The courses in the structure are classified by their level of learning by using an extension of Bloom's taxonomy as given under

Level 0: Remember and understand level of course
Level 1: Apply level of course
Level 2: Analysis level of course
Level 3: Evaluate level of Course
Level 4: Create level of course

The first numerical digit of the subject code in the course structure shows the level of course. Some of the courses which falls on the higher level of Bloom's taxonomy are assigned a component of supervised learning (represented by 'S' component in the structure) by involving the student in the project work.

DEPARTMENT VISION

To be known globally as a premier department offering quality education in Mechanical Engineering inculcating the spirit of interdisciplinary research and innovation.

DEPARTMENT MISSION

M1: Create a strong foundation on fundamentals in the areas of Mechanical Engineering through outcome based teaching learning process.

M2: Establish state-of-the-art facilities for computer aided design and simulation.

M3: To set up advanced labs in collaboration with industries to provide avenues to faculty and students to get involved in interdisciplinary research and provide solutions to Engineering problems.

M4: Involve the students in group activities, including those of professional bodies to develop leadership and communication skills.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEO1 – Accomplishment: Graduates will lead successful professional life by applying their domain specific knowledge demonstrating leadership skills with ethical attitudes in broad societal context while working in a multi/inter disciplinary setting.

PEO2 – Competence: Graduates will excel in providing ethical solutions as an individual or a member or a leader of a team by investigating, analysing, formulating and solving complex engineering problems for the sustainable development of society.

PEO3 – Expertise: Graduates will exhibit professionalism while communicating with local, national and foreign peers bound with regulations and leading life- long learning.

PROGRAM OUTCOMES (POs):

PO1: Core Knowledge: Graduates will demonstrate an ability to identify, formulate and solve complex engineering problems in the area of specialization and evaluate them to select optimal feasible solution considering safety, environment and other realistic constraints.

PO2: Modern and Advanced Tools: Graduates will demonstrate skills to use modern engineering tools, software and equipment to analyze and solve complex engineering problems using multidisciplinary approach.

PO3: Research Aptitude: Graduates will demonstrate skill of good researcher to work on a problem, starting from scratch, to research into literatures, methodologies, techniques, tools, and conduct experiments and interpret data to develop methodologies, techniques, modern tools and products for the betterment of society.

PO4: Report Writing: Graduates will be able to present their work unequivocally before scientific community through reports and presentations to give and take clear instructions.

PO5: Ethics and Sustainable Development: Graduates will exhibit the traits of professional integrity and ethics and demonstrate the responsibility to implement the research outcome for sustainable development of the society.

Program Specific Outcomes (PSOs):

PSO1: Professional Excellence (Mastery): Graduates will demonstrate research skills to critically analyze complex Design and Production problem for synthesizing new and existing information for their solutions

PSO2: Research problem solving skills: Graduates will be able to take up real life and/or research related problems and to create optimal solutions of these problems through comprehensive analysis and prototyping

CREDIT DISTRIBUTION

MECHANICAL ENGINEERING (MACHINE DESIGN)

Semester wise Credit Distribution

Semester	Credits	Contact Hrs/Week
I	21	19
II	21	20
III	15	9
IV	12	0
Total Credits	**69**	48

Category wise Credit Distribution

Sr. No	Category	Credit(s)	% of Total Credits
1	Basic Science courses (BSC)	3	4.28
2	Engineering Science courses including workshop, drawing, basics of electrical/mechanical/computer etc. (ESC)	4	5.71
3	Professional core courses (PCC)	31	44.28
4	Professional Elective courses relevant to chosen specialization/branch (PEC)/APCC	15	21.42
5	Project work, seminar and internship in industry or elsewhere (PRJ)	17	24.28

COURSE STRUCTURE

MECHANICAL ENGINEERING (Machine Design Engineering)

Course Structure: M.Tech. 2021-23

Semester - I

S. No.	Course Code	Category	Course Title	L	T	P	S	Credit(s)	Contact Hrs/week
1	ME-3301	PCC	Advanced Mechanical Vibration	3	0	0	1	4	3
2	ME-3302	PCC	Advanced Mechanics of Solid	3	0	0	1	4	3
3	ME-4301	PCC	Design of Mechanical Systems	3	0	0	1	4	3
4	ME-4302	PCC	Solid Modeling Lab	0	0	2	1	3	4
5	ME-2301	PCC	Advanced Machining Processes	3	0	0	0	3	3
6	MA-3006	BSC	Advanced Engineering Mathematics	3	0	0	0	3	3
							Total Credits	21	
							Total Contact Hours/week		19

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Semester – II

S.No.	Course Code	Category	Course Title	L	T	P	S	Credit(s)	Contact Hrs./week
1	ME-3303	PCC	Finite Element Methods in Engineering	3	0	1	1	5	5
2	ME-3304	PCC	Optimization Methods in Engineering	3	0	0	0	3	3
3	ME-4303	ESC	Research Methodology in Science & Engineering	3	0	0	1	4	3
4	ME-XXXX	PEC	Departmental Elective – I	3	0	0	0	3	3
5	ME-XXXX	PEC	Departmental Elective – II	3	0	0	0	3	3
6	ME-XXXX	PEC	Departmental Elective – III	3	0	0	0	3	3
			Total Credits					21	
			Total Contact Hours/week						20

WISDOM

Semester - III

S.No	Course Code	Category	Course Title	L	T	P	S	Credit(s)	Contact Hrs./week
1	ME-3305	PCC	Composite Materials	3	0	0	1	4	3
2	ME-4500	PRJ	Dissertation – I	0	0	0	5	5	0
3	ME-XXXX	PEC	Departmental Elective – IV	3	0	0	0	3	3
4	ME-XXXX	PEC	Departmental Elective – V	3	0	0	0	3	3
			Total Credits					15	
			Total Contact Hours/week						9

Semester - IV

S. No.	Course Code	Category	Course Title	L	T	P	S	Credit(s)	Contact Hrs/week
1	ME-4600	PRJ	Dissertation – II	0	0	0	9	9	0
2	ME-3400	PRJ	Dissertation Viva Voce	-	-	-	3	3	0
			Total Credits					12	
			Total Contact Hours/week						0

Departmental Elective(s) - I, II and III Mechanical Engineering (Machine Design)

S. No.	Course Code	Course Title	L	T	P	S	Credit(s)
1	ME-3306	Tribology of Bearings	3	0	0	0	3
2	ME-3307	Nonlinear Vibrations	3	0	0	0	3
3	ME-3308	Fracture, Fatigue and Failure Analysis	3	0	0	0	3
4	ME-3309	Industrial Noise Control	3	0	0	0	3

Departmental Elective(s) - IV & V Mechanical Engineering (Machine Design)

S. No.	Course Code	Course Title	L	T	P	S	Credit(s)
1	ME-4304	Condition Monitoring of Machines	3	0	0	0	3
2	ME-3310	Fracture Mechanics	3	0	0	0	3
3	ME-4305	Experimental Stress Analysis	3	0	0	0	3

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Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - I

(Professional core courses)

ME-3301 L-T-P-S-C
Advanced Mechanical Vibration 3-0-0-1-4

Pre-requisite Nil

Objective: *The course will be able to mathematically model real-world mechanical vibration problems and familiarize to impart the knowledge of single degree and multi degree vibration and its analysis.*

Course Outcome: *Students will be able to*

1. *Investigate vibratory response of mechanical system,*
2. *Evaluate the constraints of vibration isolation system,*
3. *Mechanize the vibrations to the tolerable level.*

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: Introduction

Introduction

Generalized co-ordinates, constraints, virtual work; Hamilton's principle, Lagrange's equations; Discrete and continuous system.

Module 02: Vibration absorbers

Vibration absorbers; Response of discrete systems - SDOF & MDOF: free-vibration, periodic excitation and Fourier series, impulse and step response, convolution integral

Module 03: Modal analysis:

Modal analysis: undamped and damped non- gyroscopic, undamped gyroscopic, and general dynamical systems. Effect of damping

Module 04: Continuous systems

Continuous systems: vibration of strings, beams, bars, membranes and plates

Module 05: Free and forced vibrations

free and forced vibrations; Raleigh-Ritz and Galerkin's methods. Measurement techniques

Text/Reference Books

1. L Meirovitch, Elements of Vibration Analysis, McGraw Hill, Second edition, 1986.
2. Meirovitch, Principles & Techniques of Vibrations, Prentice Hall International (PHIPE), New Jersey, 1997.
3. W T Thomson, Theory of Vibration with Applications, CBS Publ., 1990.
4. F S Tse, I E Morse and R T Hinkle, Mechanical Vibrations, CBS Publ., 1983.
5. J S Rao and K Gupta, Theory and Practice of Mechanical Vibrations, New Age Publication, 1995

Digital Material

https://m.youtube.com/watch?v=Y03mdTyhnL0

WISDOM

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - I

(Professional Core Courses)

ME-3302 L-T-P-S-C
Advanced Mechanics of Solids 3-0-0-1-4

Pre-requisite Solid Mechanics

Objective: *This subject is designed to discuss the designing theories for different mechanical components*

Course Outcome: *Students will be able to:*

1. *Understanding designed to give fundamental knowledge of mechanics of deformable solids.*
2. *Analysis of stress, strain, stress –strain relations, theories of failure and energy methods.*

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: Analysis of Stresses and Strains

Analysis of Stresses and Strains in rectangular and polar coordinates: Cauchy's formula, Principal stresses and principal strains, 3D Mohr's Circle. Octahedral Stresses, Hydrostatic and deviatoric stress

Module 02: Differential equations of equilibrium

Differential equations of equilibrium, Plane stress and plane strain, compatibility conditions. Introduction to curvilinear coordinates. Generalized Hooke's law and theories of failure.

Module 03: Energy Methods

Energy Methods. Bending of symmetric and unsymmetric straight beams, effect of shear stresses. Curved beams, Shear center and shear flow, shear stresses in thin walled sections, thick curved bars.

Module 04: Torsion of prismatic solid sections

Torsion of prismatic solid sections, thin walled sections, circular, rectangular and elliptical bars, membrane analogy. Thick and thin walled cylinders, Composite tubes, Rotating disks and cylinders

Module 05: Euler's buckling load

Euler's buckling load, Beam Column equations. Strain measurement techniques using strain gages, characteristics, instrumentations, principles of photo-elasticity

Text/Reference Books

1. L. S. Srinath, Advanced Mechanics of Solids, 2nd Edition, TMH Publishing Co. Ltd., New Delhi, 2003.
2. R. G. Budynas, Advanced Strength and Applied Stress Analysis, 2nd Edition, McGraw Hill Publishing Co, 1999.
3. A.P. Boresi, R. J. Schmidt, Advanced Mechanics of Materials, 5th Edition, John Willey and Sons Inc, 1993.
4. S. P. Timoshenko, J. N. Goodier, Theory of Elasticity, 3rd Edition, McGraw Hill Publishing Co. 1970.
5. P. Raymond, Solid Mechanics for Engineering, 1st Edition, John Willey & Sons, 2001.
6. J. W. Dally and W. F. Riley, Experimental Stress Analysis, 3rd Edition, McGraw Hill Publishing Co., New York, 1991.

Digital Material
https://m.youtube.com/watch?v=GyAD3y6eatQ&t=826s

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - I

(Professional Core Courses)

ME-4301 L-T-P-S-C
Design of Mechanical Systems 3-0-0-1-4

Prerequisite Nil

Objective: The aim of this course is to familiarize with the concept of system and methodology of system. This course also impart necessary knowledge of design of various systems such as snatch block, belt conveyors, engine system, pumps and machine tool gearbox.

Course Outcome: The students will be able to

1. Implement the concept of system design.
2. Design material handling systems such as hoisting mechanism of EOT crane,
3. Design belt conveyor systems, design engine components such as cylinder, piston, connecting rod and crankshaft.
4. Design pumps for the given applications and prepare layout of machine tool gear box and select number of teeth on each gear.

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01 Introduction

Methodology & Morphology of design, Optimum design, system concepts in design.

Module 02: Design of Hoisting mechanism

Design of Hoisting mechanism: Design of Snatch Block Assembly including Rope Selection, Sheave, Hook, Bearing for hook, cross piece, Axle for sheave and shackle plate, Design of rope drum, selection motor with transmission system.

Module 03: Design of belt Conveyors

Design of belt Conveyors- Power requirement, selection of belt, design of tension take up unit, idler pulley

Module 04: Engine Design (Petrol and Diesel):

Engine Design (Petrol and Diesel): Design of cylinder, Piston with pin and rings, connecting rod & crankshaft with bearings

Module 05: Design of Pump:

Design of main components of the gear pump. Motor selection, Gear design, Shaft design and bearing selection,Casing and bolt. Design, Suction and delivery pipe Design of main components of Centrifugal Pump: Motor selection, Suction and Delivery pipe, Design of Impeller, Impeller shaft, Design of Volute Casing.

Module 06: Design of Gear Box:

Design of gear boxes for machine tool applications(Maximum three stages and twelve speeds), Requirements of gear box, determination of variable speed range, graphical representation of speeds, structure diagram, ray diagram, selection of optimum ray diagram, estimation of numbers of teeth on gears, deviation diagram, layout of gear box.

Text/Reference Books

1. S.N.Trikha. Machine Design Exercises, Khanna Publications, Delhi
2. Shigley J E and Mischke C R. Mechanical Engineering Design, McGraw Hill
3. M FSpotts. Mechanical design analysis, Prentice Hall Inc
4. Bhandari VB. Design of Machine Elements,, TMH
5. Black PH and O Eugene Adams. Machine Design, McGraw Hill

6. Design Data by P.S.G. College of Technology, Coimbatore.
7. I S: 2825 Code for unfired pressure vessels
8. Mechanical Design Synthesis with Optimisation Applications byJohnson R C, Von Nostrand-Reynold Pub
9. Dieter G E. Engineering Design by, McGraw Hill Inc
10. S K Basu and D K Pal. Design of machine tools, Oxford and IBH Pub. Co.
11. NKMehta. Machine tool design, TMH
12. SP Patil,Mechanical System Design, JAICO students Ed., JAICO Publishing House
13. G K Sahu. Pumps: Theory, Design and Applications, New Age International
14. Khandare S.S & Kale A.V. Design Data Book- Design of engine parts.

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - I

(Professional core courses)

ME-4302 L-T-P-S-C
Solid Modeling Lab 0-0-2-1-3

Prerequisite Nil

Objective: *This course is designed to give the students practical knowledge about virtual design. The students would learn how to make a solid model and analyse it.*

Laboratory Outcome: *Students will be able to...*

1. Understand solid modeling software's commands and apply it in the solid part & sheet metal drawing.

2. Draw and interpret detailed drawings of a given object. Read and interpret the drawing.

3. Prepare detailed drawing of any given physical object/machine element with actual measurements.

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

List of Experiments

S. No.	Title of the Experiment
1.	Introduction to the solid modeling software

2.	Basics of sketcher geometry, tools & datum features
3.	Dimensioning commands and principles.
4.	Extrusion and ribs commands
5.	Holes, chamfer, shells & round commands
6.	Exercises on group, copy, mirror commands
7.	Pattern commands
8.	Practice on Revolve, sweep, protrusion commands
9.	Assembly with constraint
10.	Introduction to sheet metal design
11.	Primary and secondary sheet metal wall features
12.	Modifying sheet metal models
13.	Working drawing

Text/Reference Books

1. ATC's Part (Basic) & Assembly Modeling (Basic) - Creo 2.0, PTC, PL-2019-01 Arbortext, 2012.

2. ATC's Part (Adv) & Flexible Modeling -Creo 2.0, PTC, PL-2049-01 Arbortext, 2012

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - I

(Professional Core Courses)

ME-2301 L-T-P-S-C
Advanced Machining Processes 3-0-0-0-3

Pre-requisite Nil

Objective: *The aim of this course is to impart knowledge of various modern manufacturing processes, their characteristics & process parameters.*

Course Outcome: *After completion of this course, students will be able to:*

1. *Understand the applied aspects of advanced machining processes.*
2. *Understand modeling and simulation of non traditional machining processes.*

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: General classification of unconventional machining processes; Abrasive jet machining, water jet and abrasive water jet machining, ultrasonic machining.

Module 02: Electric discharge machining and allied processes, laser beam machining, ion beam machining, plasma arc machining;

Module 03: Electro chemical machining (ECM) and allied processes, ECM tool design, chemical machining, photochemical machining; Elastic emission machining

Module 04: Advanced finishing processes, abrasive flow finishing, magnetic abrasive finishing, magnetorheological finishing, chemomechanical polishing; Comparative evaluation of different unconventional machining processes

Module 05: Analytical modeling of mechanical, thermal and electrochemical type nontraditional machining processes; Numerical modeling and simulation of unconventional machining processes; Computer aided process planning of non-traditional machining processes

Text/Reference Books

1. Jain V. K., Advanced Machining Processes, Allied Publishers,2009.
2. Gary F. Benedict, Nontraditional Manufacturing Processes, Taylor & Francis, 1987.
3. McGeough J. A. , Advanced Methods of Machining, Springer, 1988.
4. Mishra P. K., Non Conventional Machining, Narosa India Publication, 1997.
5. Hassan El-Hofy, Advanced Machining Processes: Nontraditional and Hybrid Machining Processes, McGraw-Hill Prof Med/Tech, 2005.
6. Pandey P. C. and Shan H. S., Modern Machining Processes, Tata McGraw-Hill Education, 1980.
7. Brown J. A., Modern Manufacturing Processes, Industrial Press, 1991.
8. Jain V. K., Introduction to Micromachining, Alpha Science International Limited, 2010.

Digital Material

https://www.youtube.com/watch?v=dmHv42wda9k
https://www.youtube.com/watch?v=tTnXn498F90
https://www.youtube.com/watch?v=kh4DSOtef4k
https://m.youtube.com/watch?v=Jg6YXvTO5FE

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - I

(Basic Science courses)

MA-3006 L-T-P-S-C
Advanced Engineering Mathematics 3-0-0-0-3

Pre-requisites: Vector-Tensor Analysis in Cartesian system, effect of rotation of coordinate systems, ODEs; Laplace & Fourier methods, series solutions, and orthogonal polynomials. Sturm-Liouville problem. 1st and 2nd order PDEs will be discussed with the relevant topics during the course.

Objective: *In this course certain advanced numerical techniques with probability and statistics will be discussed. These concepts play a very important role in all the fields of engineering.*

Course Outcomes: After completion of the course a successful student can

CO1: Acquire Fundamental knowledge in

(a) Solution of System of Linear and Non-linear algebraic equations
(b) Numerical solution of ODEs & PDEs
(c) Probability and Statistics

CO2: Develop skills in analyzing the

(a) ill conditioned systems
(b) properties of functions through numerical integration
(c) properties of numerical solutions of differential equations

(d) Error estimates
(e) Stability of Solutions

CO3: Develop skills in designing mathematical models for

(a) ODEs & PDEs
(b) Linear & Non-linear systems of algebraic equations

CO4: Develop numerical skills in solving the problems involving

(a) Linear systems of algebraic equations
(b) Systems of nonlinear algebraic equations
(c) ODEs
(d) PDEs

CO5: Apply the statistical techniques for various engineering problems

PO1	PO2	PO5	PSO1	PSO2
1	1	1	1	1

Course Content

Module 01: **Solution of linear systems of algebraic equations**

Linear system of algebraic equations. Gauss elimination, LU decomposition etc., Matrix inversion, ill-conditioned systems. Numerical eigen solution techniques (Power, Householder, QR methods etc.).

Module 02: Numerical solution of systems of nonlinear algebraic equations

Numerical solution of systems of nonlinear algebraic equations; Newton-Raphson method. Numerical integration: Newton-Cotes methods, error estimates, Gaussian quadrature.

Module 3: Numerical solution of ODEs

Numerical solution of ODEs: Euler, Adams, Runge-Kutta methods, and predictor-corrector procedures;

Module 4: Solution of PDEs

Stability of solutions; solution of stiff equations. Solution of PDEs: finite difference techniques.

Module 5: Probability and Statistics

Probability and Statistics – Probability Distribution, Bays Theorem, Parameter Estimation, Testing of Hypothesis, Goodness of Fit.

Text/Reference Books

1. Advanced Engineering Mathematics. Kreyszig E. 10th Ed., Wiley Eastern 2012.
2. Numerical Methods for Scientific and Engineering Computation. Jain M. K.,Iyengar S. R. K. and Jain R. K.3rd Ed., New Age International 1993.
3. Computational Methods for Partial Differential Equations, Jain M.K., Iyenger S.R.K. and R. Jain, R.K. New Age International, 1994
4. Methods of Mathematical Physics Courant R. and Hilbert D. Wiley, 1989.
5. Mathematical Methods for Physicists. Arfken G. B., Weber H. J. and Harris F. 5th Ed., Academic Press.

Digital Material

1. Power Point Slides covering the course lectures shall be uploaded on the local server connected through Intranet
2. Course content, video demonstration, problem sets etc. shall be made available on the course page of the Moodle site developed by the course teacher

PS WISDOM

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - II

(Professional core courses)

ME-3303 L-T-P-S-C
Finite Element Methods in Engineering 3-0-1-1-5

Pre-requisite Nil

Objective: *This course deals with finite element methods as a tool for solving various engineering problems computationally. It includes fundamentals of FEA and mathematical modeling of 1-D, 2-D and dynamic problems. It also includes* preprocessors, postprocessors and finite element packages for solving FEA problems.

Course Outcome: *Students will be able to*

1. Discuss the need and basic concepts of FEA.

2. Explain the direct and formal (basic energy and weighted residual) methods for deriving finite element equations.

3. Solve 1-D, 2-D, Axi-symmetric and dynamic problems using the Finite Element Analysis approach.

4. Apply a finite element simulation tool to solve practical problems.

PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	1	1	1	0	1	1

Course Content

Module 01: Introduction & Overview and history of the FEM: Basic concept of FEM, Mathematical model, numerical simulation. 2) Historical back ground, General & Engineering applications. 3) Basic element shapes, Discretization process, Node numbering scheme.

Module 02: Variation methods: Variation principles and methods, variation formulation, Rayleigh-Ritz method, Galerkin's methods.

Module 03: 1-D problems & 2-D problems: formulation by different approaches (direct, potential energy and Galerkin); Finite element equations, treatment of B.C., Quadratic shape functions, temperature effects, 2-D-Constant-strain Triangle (CST), Problem modelling and BC's, Orthotropic materials.

Module 04: Axisymmetric solids with axisymmetric loading: Axisymmetric formulation, FEM: triangular elements, Problem modelling and BC's. 2-D iso-parametric elements: Four node quadrilaterals, Numerical integration, Higher order elements.

Module 05: Bending of beams, analysis of truss and frame.Plane stress and plane strain problems; Bending of plates; Eigenvalue and time dependent problems.

Module 06: Numerical considerations: numerical integration, error analysis, mesh refinement. Discussion about preprocessors, postprocessors and finite element packages.

List of Experiments

S. No.	Title of the Experiment	Module
1.	Modeling and stress analysis of Trusses	5
2.	Determination of load required to achieve a desired total extension of the spring	5

3.	Modeling and stress analysis of Bars of constant cross section area, tapered cross section area and stepped bar.	5
4.	Modeling and stress analysis of Beams -Simply supported, cantilever, beams with UDL, and beams with varying load etc.	5
5.	Stress analysis of tapered cantilever with two load cases	5
6.	Stress analysis of a rectangular plate with a circular hole, axisymmetric problems.	5
7.	Dynamic Analysis of a Fixed -fixed beam for natural frequency determination	6
8.	Dynamic Analysis of a Fixed -fixed beam subjected to forcing function	6
9.	Simulation of 1-D Heat transfer with radiation	6
10.	Thermal Analysis -2D problem with conduction and convection boundary conditions	6

Text/Reference Books:

1. Seshu P., "Text book of Finite Element Analysis", Prentice Hall of India.
2. Reddy J. N., "An introduction to the Finite Element Method", McGraw-Hill, New York, 1993.
3. Chandrupatla and Belegundu, "Introduction to Finite Elements in Engineering", Pearson Education.
4. Bathe K. J., Finite Element Procedures in Engineering Analysis, Prentice-Hall, Englewood Cliffs, NJ, 1982.
5. Dhanraj R. and Prabhakaran Nair K., "Finite Element Methods", Oxford University Press.
6. Logan D. L., "A first course in Finite Element Method" Thomson Asia Pvt Ltd.
7. Cook R. D., Malkus D. S., Plesha M.E., "Concepts and Applications of Finite Element Analysis", , 3rd edition., John Wiley, New York, 1989.
8. Rao S. S.,"The Finite Element Method in Engineering", Butter Worth Heinemann.
9. Kent Lawrence, "ANSYS Workbench Tutorial Release 14, Structural and Thermal Analysis" Schroff Development Corporation.
10. Nitin S. Gokhale, Sanjay S. Despande, Dr. Anand N. Thite, "Practical Finite Element Analysis".
11. Srinivas Paleti, Sambana, Krishna Chaitanya, Datti, Rajesh Kumar, "Finite Element Analysis using ANSYS", PHI Publication.

Digital Material:

1. https://www.youtube.com/watch?v=Tw-o1rQuf7Y
2. https://nptel.ac.in/courses/112/104/112104116/
3. https://www.youtube.com/watch?v=4c-sPXolD0w

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - II

(Professional core courses)

ME-3304 L-T-P-S-C
Optimization Methods in Engineering 3-0-0-0-3

Pre-requisite Nil

Objective: *To describe the techniques & applications of engineering optimization to the students, so they are able to design & produce products both economically & efficiently*

Course Outcome: *The students will be able to*

1. Explain the fundamental knowledge of optimization & Linear Programming, Non linear programming and use classical optimization techniques and numerical methods of optimization.

2. Enumerate fundamentals of Geometric Programming, Integer programming technique and apply different techniques to solve various optimization problems arising from engineering areas.

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: Introduction to Optimization

Engineering Applications of Optimization, Statement of an Optimization Problem, Design Vector, Design Constraints, Constraint Surface, Objective Function, Objective Function Surfaces, Classification of Optimization Problems.

Module 02: Classical Optimization Techniques

Introduction, Single-Variable Optimization, Multivariable Optimization with No Constraints, Semi definite Case, Saddle Point, Multivariable Optimization with Equality Constraints, Solution by Direct Substitution, Solution by the Method of Constrained Variation, Solution by the Method of Lagrange Multipliers, Multivariable Optimization with Inequality Constraints , Kuhn-Tucker Conditions.

Module 03: Linear Programming

Introduction, Applications of Linear Programming, Standard Form of Linear Programming Problem, Geometry of Linear Programming Problems, Solution of a System of Linear Simultaneous Equations, Two Phases of the Simplex Method.

Module 04: Nonlinear Programming

Introduction, Unimodal Function, ELIMINATION METHODS: Unrestricted Search, Search with Fixed Step Size, Search with Accelerated Step Size, Exhaustive Search, Dichotomous Search, Interval Halving Method, Fibonacci Method, Golden Section Method, Comparison of Elimination Methods, INTERPOLATION METHODS, Direct Root Methods, Newton Method, Quasi-Newton Method.

Module 05: Geometric Programming

Introduction, Posynomial, Unconstrained Minimization Problem, Solution of an Unconstrained Geometric Programming Program Using Differential Calculus, Solution of an Unconstrained Geometric Programming Problem Using, Arithmetic–Geometric Inequality, Primal–Dual Relationship and Sufficiency Conditions in the Unconstrained Case, Constrained Minimization , Solution of a Constrained Geometric Programming Problem.

Module 06: Integer Programming & Modern Methods of Optimization

Integer linear programming: Introduction, Graphical Representation, Gomory's Cutting Plane Method, Concept of a Cutting Plane Gomory's Method for All-Integer Programming Problems, Gomory's Method for Mixed-Integer Programming Problems, Branch-and-Bound Method. Modern Methods of Optimization: Introduction, Genetic Algorithms, Representation of Design Variables, Representation of Objective Function and Constraints, Genetic Operators.

Text/Reference Books

1. Optimization: Theory & Applications. Rao S. S.2nd Ed. Wiley Eastern.1984.
2. Optimization for Engineering Design-Algorithms & Examples. Deb K. PHI. 1995.
3. Introduction to Optimum Design. Arora J. S. McGraw-Hill. 1989.
4. Engineering Optimization- Methods & Applications. Reklaitis G. V., Ravindran A. & Ragsdell K. M. Wiley. 1983.
5. Optimization Methods for Engineering Design. Fox R. L. Addison Wesley. 1971.

***Digital Material:**

https://www.youtube.com/watch?v=-x6eWf-x9SE

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - II

(Professional core courses)

ME-4303 L-T-P-S-C
Research Methodology in Science & Engineering 3-0-0-1-4

Pre-requisite Nil

Objective: *The objectives of this course are to understand Research and Research Process, acquaint students with identifying problems for research and develop research strategies, familiarize students with the techniques of data collection, analysis of data and interpretation.*

Course Outcome: *The students will be able to*

1. *To get introduced to research philosophy and processes in general.*
2. *To formulate the research problem and prepare a research plan.*
3. *To communicate the research findings effectively.*

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: Introduction and Basic Research Concepts

Research – Definition; Concept of Construct, Postulate, Proposition, Thesis, Hypothesis, Law, principle Research methods vs Methodology, Need of Research in Business and Social Sciences, Objectives of Research Issues and Problems in Research, Characteristics of Research: Systematic, Valid, Verifiable, Empirical and Critical

Module 02: Types of Research

Basic Research, Applied Research, Descriptive Research, Analytical Research, Empirical Research, Qualitative and Quantitative Approaches

Module 03: Research Design and Sample Design

Research Design – Meaning, Types and Significance, Sample Design – Meaning and Significance Essentials of a good sampling Stages in Sample Design Sampling methods/techniques Sampling Errors

Module 04: Research Methodology

Meaning of Research Methodology, Stages in Scientific Research Process: Identification and Selection of Research Problem, Formulation of Research Problem, Review of Literature, Formulation of Hypothesis, Formulation of research Design, Sample Design, Data Collection, Data Analysis, Hypothesis testing and Interpretation of Data, Preparation of Research Report

Module 05: Formulating Research Problem

Considerations: Relevance, Interest, Data Availability, Choice of data, Analysis of data, Generalization and Interpretation of analysis

Module 06: Outcome of Research

Preparation of the report on conclusion reached, Validity Testing & Ethical Issues, Suggestions and Recommendation

Text/Reference Books

1. Dawson C, “Practical Research Methods”, UBS Publishers Distributors.
2. Kothari C. R., “Research Methodology: Methods and Techniques”, Wiley Eastern Limited.

3. Kumar R., “Research Methodology: A Step-by-Step Guide for Beginners”, Pearson Education.

***Digital Material:**

https://nptel.ac.in/courses/110/105/110105091/

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - II

(Professional Elective courses)

ME-3306 L-T-P-S-C
Tribology of Bearings 3-0-0-0-3

Pre-requisite Nil

Objective: *This course discusses the theory of bearing and lubrication. To enhance students' awareness of tribological issues in the design of different types of bearings, such as rolling element bearings, journal bearings and thrust bearings.*

Course Outcome: *Students will be able to*

1. Describe a fundamental understanding of Tribology of Bearings.

2. Demonstrate basic understanding of friction, lubrication, and wear processes.

3. Design a tribological system for optimal performance.

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: Introduction, Properties and Testing of Lubricants, Basic Equations, Idealized Hydrodynamic Bearings.

Module 02: Finite Bearings, Oil Flow and Thermal equilibrium, Bearing Design, Squeeze Film bearings, Hydrodynamic Instability. Externally pressurized Oil Bearings. Gas-lubricated Bearings.

Module 03: Elasto-hydrodynamic Lubrication, Surface Roughness Effect on Hydrodynamic Bearings and Elasto-hydrodynamic Line contacts.

Module 04: Ball Bearings, Roller Bearings. Friction of Metals. Wear of Metals.

***Text/Reference Books**

1. B C Majumdar, 1999, "Introduction to Tribology of Bearings", A. H. Wheeler & Co. Ltd., New Delhi.
2. Pinkus, O. and Sternlicht, B., 1961, "Theory of hydrodynamic lubrication", Mc Graw Hill Book Co. Inc., New York.
3. A Cameron and C.M. Mc Ettles, 1987, "Basic Lubrication Theory", Wiley Eastern Ltd., New Delhi.

***Digital Material**

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Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - II

(Professional Elective courses)

ME-3307 L-T-P-S-C
Nonlinear Vibrations 3-0-0-0-3

Pre-requisite Nil

Objective: *This course discusses the nonlinear vibration and its analysis. This course will introduce the students to the basics of nonlinear dynamics with a specific emphasis on second order systems representing vibration problems. The student will understand and appreciate the importance of nonlinear vibrations in mechanical design of machine parts.*

Course Outcome: *The student will able to*

1. *Analyse vibration of multi degree of freedom nonlinear systems.*
2. *Develop* mathematical model of real-world mechanical vibration problems.

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: Mechanical Vibrations Dynamics of conservative and non-conservative systems; Phase planes, fixed points; Local and global stability, Lyapunov theory

Module 02: Analytical solution methods: Harmonic balance, equivalent linearization, perturbation techniques (Linstedt- Poincare, Multiple Scales, Averaging–Krylov-Bogoliubov-Mitropolsky); Damping mechanisms; self-excited systems, Van der Pol's oscillator

Module 03: Forced oscillations of SDOF systems, Duffing's oscillator; primary-,secondary-, and multiple- resonances; period multiplying bifurcations; Poincare' maps, point attractors, limit cycles and their numerical computation, strange attractors and chaos

Module 04: Types of bifurcations, Lyapunov exponents and their determination, fractal dimension. Parametric excitations, Floquet theory, Mathieu's and Hill's equations; effects of damping and nonlinearity

Module 05: MDOF systems, solvability conditions, internal (auto parametric) resonances; Hopf bifurcation and panel flutter example. Application to continuous systems.

***Text/Reference Books**

1. Nayfeh, A. H., and Mook, D. T., Nonlinear Oscillations, Wiley-Interscience, 1979..
2. Hayashi, C. Nonlinear Oscillations in Physical Systems, McGraw-Hill, 1964.
3. Evan-Ivanowski, R. M., Resonance Oscillations in Mechanical Systems, Elsevier, 1976.
4. Nayfeh, A. H., and Balachandran, B., Applied Nonlinear Dynamics, Wiley, 1995.
5. Seydel, R., From Equilibrium to Chaos: Practical Bifurcation and Stability Analysis, Elsevier, 1988.
6. Moon, F. C., Chaotic & Fractal Dynamics: An Introduction for Applied Scientists and Engineers, Wiley, 1992.
7. Srinivasan, P. Nonlinear Mechanical Vibrations, New Age International, 1995.
8. Rao, J. S., Advanced Theory of Vibration: Nonlinear Vibration and One-dimensional Structures, New Age International, 1992.

***Digital Material**

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Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester – II

(Professional Elective courses)

ME-3308 L-T-P-S-C
Fracture, Fatigue and Failure Analysis 3-0-0-0-3

Pre-requisite Nil

Objective: *The objective of this course is to introduce the mathematical and physical principles of fracture mechanics and their applications to engineering design to develop the ability in students to compute the stress intensity factor, strain energy release rate, and strain fields around a crack tip for linear and non linear materials.*

Course Outcome: *Students will be able to*

1. *Apply fracture mechanics to predict brittle fracture.*
2. *Identify and describe the basic fracture and fatigue mechanisms.*
3. *Understand crack resistance and energy release rate for crack criticality.*
4. *Identify the cause of failure of a material based on fracture surface observations.*

PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	1	1	0	0	1	0

Course Content:

Module 01: Griffith's theory of brittle failures; Irwin's stress intensity factors; Linear elastic fracture mechanics.

Module 02: The stress analysis of crack tips, Macroscopic theories in crack extension, Instability and R-curves, Crack tip plasticity, K as a failure criterion, Mixed mode of fracture.

Module 03: Analytical and Experimental methods of determining K; Elastic plastic fracture mechanics: Crack tip opening displacement, J Integrals, Crack growth resistance curves, Crack tip constraint under large scale yielding, creep crack growth.

Module 04: Microscopic theories of fracture: Ductile and cleavage fracture, ductile-brittle transition, inter-granular fracture; Fatigue crack propagation: Fatigue crack growth theories, crack closure, Microscopic theories of fatigue crack growth.

Module 05: Application of theories of fracture mechanics in design and materials development.

***Text/Reference Books**

1. Anderson T. L., Fracture Mechanics Fundamentals and Applications, CRC Press, 1994
2. Brock D., Elementary Engineering Fracture Mechanics, Maritinus Nijhoff Publishers, 1982.
3. Rolfe S. T. and. Barson J. M, Fracture and Fatigue Control in Structures, PHI, 1977
4. Gere J. M. and Barry J. G., Mechanics of Materials, Seventh Edition, Cengage Learning

***Digital Material**

https://youtu.be/-eBRqhfdGrU
https://www.youtube.com/watch?v=G5mcTw-PLEI
https://www.youtube.com/watch?v=H5yo2dvaalU

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester – II

(Professional Elective courses)

ME-3309 L-T-P-S-C
Industrial Noise Control 3-0-0-0-3

Pre-requisite Nil

Objective: *This course provides a comprehensive overview of industrial noise quality and the science and technology associated with the monitoring and control it.*

Course Outcome: *Students will be able to*

1. Identify the sources of noise in industry.

2. Develop the concepts involved in control technologies.

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: Principles of sound generation and propagation, sound attenuation, sound absorption.

Module 02: Sources of industrial noise, effects of noise, noise measurement units and instruments.

Module 03: Identification of source of noise, noise evaluation procedures, acoustical enclosures.

Module 04: Design of reactive and absorptive mufflers, active noise control, designing for quieter machines and processes, case studies.

***Text/Reference Books**

1. Leo L. Beranek, Noise and Vibration Control, McGraw-Hill, 1971
2. J. D. Irwin and E. R. Graf, Industrial Noise and Vibration Control, Prentice Hall, 1979
3. Cyril M Harris, Handbook of Noise Control, McGraw-Hill
4. Baxa, Noise Control in Internal Combustion Engines, Wiley, 1982
5. Harold Lord, Gatley and Eversen, Noise Control for Engineers, McGraw-Hill
6. R. H. Lyon, Machinery Noise and Diagnostics, Butterworths, 1987.

***Digital Material**

https://youtu.be/PU2e4_89WgI

Detailed Syllabus for M. Tech. Degree Programme in Mechanical Engineering (Machine Design Engineering)

Semester - III

(Professional core courses)

ME-3305 L-T-P-S-C
Composite Materials 3-0-0-1-4
Pre-requisite Nil

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

Course Outcome: *The students will be able to*

1. *Describe basic concepts of composite materials and their uses*
2. *Apply micro-mechanical analysis of lamina and predict the failure behaviour of fibre-reinforced composites*
3. *Analyse the elastic properties and the mechanical performance of composite laminates*
4. *Apply macro-mechanical analysis of laminates and predict the failure behaviour of laminates.*

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: Introduction

Definition, Characteristics, Classification, Particulate Composites, Fiber-Reinforced Composites, factors affecting the properties of composite material, Applications of Fiber Composites.

Module 02: Fibers, Matrices, and Fabrication of Composites

Advanced Fibers, Glass Fibers, Production of Glass Fibers, Glass Composition and Properties, Forms of Glass Fiber, Carbon and Graphite Fibers, Matrix Materials, Fabrication of Composites.

Module 03: Micromechanical analysis of lamina (Longitudinal Behavior of Unidirectional Composites)

Introduction, Nomenclature, Volume and Weight Fractions, Longitudinal Behavior of Unidirectional Composites, Initial Stiffness, Load Sharing, Behavior beyond Initial Deformation, Failure Mechanism and Strength, Factors Influencing Longitudinal Strength and Stiffness, Transverse Stiffness· and Strength: Constant-Stress Model, Elasticity Methods of Stiffness Prediction, Halpin-Tsai' Equations for Transverse Modulus, Transvyrse Strength, Prediction of Shear Modulus, Prediction of Poisson's Ratio, Failure Modes.

Module 04: Analysis of Lamina

Introduction , Macro-mechanical analysis of lamina – Hooke's law for anisotropic, monoclinic, Orthotropic Materials, Stress-Strain Relations and Engineering Constants: Stress-Strain Relations for Specially Orthotropic Lamina, Stress-Strain Relations for Generally Orthotropic Lamina, Transformation of Engineering Constants, Hooke's Law and Stiffness and Compliance Matrices: General Anisotropic Material, Specially Orthotropic Material, Transversely Isotropic Material, Isotropic Material, Specially Orthotropic Material under Plane Stress, Compliance Tensor and Compliance Matrix, Relations between Engineering Constants and Elements of Stiffness and Compliance Matrices, Strengths ·of an Orthotropic Lamina.

Module 05: Analysis of Laminated Composites

Introduction, Laminate Strains, Variation of Stresses in a Laminate, Resultant Forces and Moments: Synthesis of Stiffness Matrix, Laminate Description System (Laminate

codes), Construction and Properties of Special Laminates Symmetric Laminates, Unidirectional, Cross-Ply, and Angle-Ply Laminates, Quasi-isotropic Laminates, Determination of Laminae Stresses and Strains, Analysis of Laminates after Initial Failure, Hygrothermal Stresses in Laminates , Concepts of Thermal Stresses, Hygrothermal Stress Calculations.

Text/Reference Books

1. Mechanics of Composite Materials. Jones R. M. 2nd Ed. Scripta Book Co.
2. Analysis & Performance of Fiber Composites. Agarwal B. D. & Broutman, J. D. 3rd Ed. John Willey & Sons. 1990.
3. Fiber Reinforced Composites: Materials Manufacturing & Design. Mallik, P. K. 3rd Ed. Marcel & Dekker. 1993.
4. Mechanics of Composite Materials. Arthur K. K. C.R.C. Press. 1997.
5. Mechanics of Laminated Composite Plates. Reddy J. N. 2nd Ed. CRC Press. 1998.
6. Composite Engineering Hand Book. Mallik P. K. 2nd Ed. Marcel & Dekker. 1997.

***Digital Material**

https://www.youtube.com/watch?v=JIcboaFIeZw
https://www.youtube.com/watch?v=kIHD4lLGmKU

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester - III

(Project work)

ME-4500	L-T-P-S-C
Dissertation -I	0-0-0-5-5
Pre-requisite	Nil

The Dissertation for M.Tech programme consists of two parts: Dissertation-I and Dissertation-II. Dissertation-I is undertaken during the III Semester.

The Dissertation is by far the most important single piece of work in the post-graduate programme. It provides the opportunity for student to demonstrate independence and originality, to plan and organize a large Dissertation over a long period and to put into practice some of the techniques students have been taught in the course. Students will choose a dissertation, in consultation with a faculty member, who will act as the Supervisor. Dissertation involves a combination of sound background research, a solid implementation, or piece of theoretical work, and a thorough evaluation of the dissertation's output in both absolute and relative terms. The very best dissertations invariably cover some new ground, e.g. by developing a complex application which does not already exit, or by enhancing some existing application or method to improve its functionality, performance etc.

The student will prepare the Dissertation report as per the prescribed format/guidelines and present the same as a seminar at the end of the semester.

The Dissertation will be evaluated continuously over the span of the III Semesters, as per the approved procedure.

PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	1	1	1	1	1	1

Detailed Syllabus for M.Tech. Degree Programme

in

Mechanical Engineering (Machine Design Engineering)

Semester – II

(Professional Elective courses)

ME-4304 L-T-P-S-C
Condition Monitoring of Machines 3-0-0-0-3

Pre-requisite Nil

Objective: *This course is intended to impart knowledge regarding the structural health monitoring based on acquired vibration signals. Introduction to machinery maintenance, basic vibration theory, fundamentals of data acquisition, principles of condition monitoring, transducers for condition monitoring, fault diagnosis in rotating machines, NDT methods in condition monitoring, wear and debris analysis, case studies in condition monitoring.*

Course Outcome:

1. *Design the architecture of an appropriate condition monitoring system for typical machines, including hardware selection and measurement system setup.*
2. *Develop vibration analysis code to implement signal analysis and to extract fault symptoms of typical rotating and reciprocating machines*.

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Content

Module 01: Introduction to machinery maintenance, basic vibration theory, fundamentals of data acquisition

Module 02: Principles of condition monitoring, transducers for condition monitoring.

Module 03: Fault diagnosis in rotating machines, NDT methods in condition monitoring.

Module 04: Wear and debris analysis, case studies in condition monitoring.

***Text/Reference Books**

1. R. A. Collacott, *Vibration Monitoring and Diagnosis*, Willey, New York, 1979
2. H. P. Bloch and F. P. Geitner, *Practical Machinery Management for Process Plants*,
3. Vol. 1, 2 3 & 4., Gulf Publishing Company, 1983
4. H. M. Harris and C. E. Crede, *Shock and Vibration Handbook*, McGraw-Hill Book Company, 1994
5. A. V. Oppenheim and R.W. Shafer, *Digital Signal Processing*, Prentice-Hall, Inc., 1975
6. V. Wowk, *Machinery Vibration Measurement and Analysis*, McGraw-Hill, Inc., 1991
7. R. B. Randall, *Frequency Analysis*, Bruel & Kjaer Publication, 1986
8. J. S. Bendat and A. G. Piersol, *Engineering applications of correlation and Spectral Analysis*, John Wiley & Sons, 1980

***Digital Material**

https://nptel.ac.in/courses/112/105/112105232/

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Detailed Syllabus for M. Tech. Degree Programme
In
Mechanical Engineering
(Machine Design Engineering)

Semester - III

(Professional Elective courses)

ME-3310 L-T-P-S-C
Fracture Mechanics 3-0-0-0-3

Pre-requisite Nil

Objective: *This course discusses nucleation and propagation of cracks and prevention. The objective of this course is to introduce the mathematical and physical principles of fracture mechanics and their applications to engineering design to develop the ability in students to compute the stress intensity factor, strain energy release rate, and the stress and strain fields around a crack tip for linear*

Course Outcome: *On completion of the course the student should be able to*

1. *Identify the material failure for any combination of applied stresses.*
2. *Evaluation of fracture failure.*

PO1	PO2	PO3	PO5	PSO1	PSO2
1	1	1	1	1	1

Course Contents

Module 01: Introduction, History and Overview, Fracture criteria, Introduction to linear elastic fracture mechanics, Analysis of simple crack problems,

Module 02: Nucleation and propagation of cracks, Correlation between microstructure and fracture behaviour in materials.

Module 03: Mechanisms of fracture, Mechanisms of fatigue crack initiation and propagation

Module 04: Evaluation of fracture toughness, factors influencing fatigue strength, life prediction, prevention of fatigue failure

***Text/Reference Books**

1. S.T. Rolfe and J.M Barson, *Fracture and fatigue control in structures*, Prentice Hall
2. David and Bruck, *Elementary Engineering Fracture Mechanics*, Norelho
3. N.E. Fros, et al, *Metal fatigue*, Clarendon Press
4. American Society for Metals, *Case histories in failure analysis*, ASM.

***Digital Material**

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Detailed Syllabus for M. Tech. Degree Programme
In
Mechanical Engineering
(Machine Design Engineering)

Semester - III

(Professional Elective courses)

ME-4305 L-T-P-S-C
Experimental Stress Analysis 3-0-0-0-3

Pre-requisite Nil

Course Objectives: *This course is designed to understand the various techniques available to measure the stress and Strains using different sources. To understand the uses of strain gauges, mounting approaches and digital image correlation technique.*

Course Outcome: *After completion of this course, students will be able to*

1. *Demonstrate the different types of strain gauges.*
2. *Analyse measuring circuits and strains of different strain gauge rosettes.*
3. *Understand the concepts of Moire methods, photo elasticity, Brittle and birefringent coatings.*

PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	1	1	1	1	1	1

Course Content

Module 01: Basic equations of elasticity, Strain measurement, Ideal requirements of strain measuring devices, ideal strain gauge. Different types of strain gauges: mechanical, optical, Acoustical, pneumatic, dielectric and electrical strain gauges. Differential transformer and piezoelectric transducers

Module 02:

Electrical Resistance Strain Gauges: Gauge Factor, Gauge materials and Backing Materials. Adhesives and Protective Coatings, Bonding of Strain Gauges. Semiconductor strain gauges. Performance of Strain Gauges: Temperature compensation, Transverse sensitivity, Gauge Length, Response, Excitation level, Stability.

Module 03:

Strain Gauge Circuits and recording instruments, Strain Gauge Rosettes analysis, Stress Gauge. Photo elasticity methods - behaviour of light, plane polarized and circular polariscope. Isochromatic and isoclinic fringe patterns for two-dimensional photoelasticity, Three-dimensional photoelasticity. Applications of strain gauge in practical problems.

Module 04:

Model slicing and shear difference method. Application of coatings, effects of coating thickness, birefringent coating, brittle coating. Moire Fringe technique.

***Text/Reference Books**

1. Dally J. W. and Riely W. P., "Experimental stress analysis", Third Edition, Mc Graw-Hill International, New Delhi.1978.
2. Srinath L. S., Raghavan M. R., *Experimental Stress Analysis*, Tata McGraw-Hill.
3. Sadhu Singh, Experimental stress analysis, (6th edition) Khanna Publishers, New Delhi, 1996.
4. Hendry A.W., *Elements of Experimental Stress Analysis*, Pergamon Press.
5. Abdul Mubeen, "*Experimental Stress Analysis*", DhanpatRai and Sons, 2001.
6. Theocaris P. S., "Moire Fringes in Strain Analysis", Pergamon Press, 2002

***Digital Material**

1. https://www.youtube.com/watch?v=wYxl7tt_E7E
2. https://www.youtube.com/watch?v=r8KzP7G7Uks

Detailed Syllabus for M. Tech. Degree Programme
in
Mechanical Engineering (Machine Design Engineering)

Semester - IV

(Project work)

ME-4600 L-T-P-S-C
Dissertation -II 0-0-0-9-9

Prerequisite Dissertation - I

After completion of Dissertation-I, students will undertake the Dissertation-II in the IV Semester. The idea conceived and progress made in the Dissertation-I shall be extended as Dissertation-II under the supervision of a faculty member. Students shall complete the theoretical and practical aspect of the project. Thereafter they will prepare a report, as per the prescribed format/ guidelines, incorporating the results, their analysis and interpretation. The report, duly certified by the Supervisor, should be submitted to the Head of the Department. The report should also be presented as a seminar at the end of the semester.

Progress made by the student will be continuously monitored throughout the semester and evaluated as per the approved procedure.

PO1	PO2	PO3	PO4	PO5	PSO1	PSO2
1	1	1	1	1	1	1

Detailed Syllabus for M. Tech. Degree Programme
in
Mechanical Engineering (Machine Design Engineering)

Semester - IV

(Departmental Core Subject)

ME-3400	L-T-P-S-C
Dissertation Viva Voce	-- -- -3-3

Prerequisite — Dissertation - I

Dissertation Viva Voce is the verbal defence of the dissertation carried out by the student in front of a panel of examiners. The objective of Viva Voce examination is to confirm that the piece of work submitted as a dissertation is student's own work, he/she has a sound understanding of the subject of the dissertation, aware of the recent works in the area of dissertation, methodology adopted, and importance/relevance/merits of the output in relation with the existing results in the area.

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