SEMESTER-I

MATS UNIVERSITY, RAIPUR (C.G.)
SCHOOL OF ENGINEERING & I.T.

Semester : 1st M.Tech
Branch : Turbomachinery
Subject Finite Element methods
Code : ME 111

Course objective:
Understand the fundamental concepts of FEM.
Understanding the use and knowledge of fundamental stiffness matrix.
Know the behaviour and usage of each type of elements covered in this course.
Be able to prepare a suitable FE model for structural mechanical analysis problems.
Can interpret and evaluate the quality of the results
Be aware of the limitations of the FEM.

UNIT-I INTRODUCTION : Review of various approximate methods – Raleigh Ritz's, Galerkin and finite difference methods- Governing equation and convergence criteria of finite element method.

UNIT-II DISCRETE ELEMENTS : Bar elements, uniform sections, mechanical and thermal loading, varying section, truss analysis. Beam element - problems for various loadings and boundary conditions - longitudinal and lateral vibration. Use of local and natural coordinates.

UNIT-III CONTINUUM ELEMENTS : Plane stress, Plane strain and axisymmetric problems, constant and linear strain, triangular elements, stiffness matrix, axisymmetric load vector.

UNIT-IV ISOPARAMETRIC ELEMENTS : Definitions, Shape function for 4, 8 and 9 nodal quadrilateral elements, Stiffness matrix and consistent load vector, Gaussian integration

UNIT-V FIELD PROBLEM : Heat transfer problems, Steady state fin problems, Derivation of element matrices for two dimensional problems, Torsion problems.

TEXT BOOK

1. Tirupathi.R. Chandrapatha and Ashok D. Belegundu – Introduction to Finite Elements in Engineering – Printice Hall India, Third Edition, 2003.
2. Rao. S.S., Finite Element Methods in Engineering, Butterworth and Heinemann, 2001.

REFERENCES

1. Reddy J.N.–An Introduction to Finite Element Method – McGraw Hill – 2000.
2. Krishnamurthy, C.S., Finite Element Analysis, Tata McGraw Hill, 2000.
3. Bathe, K.J. and Wilson, E.L., Numerical Methods in Finite Elements Analysis, Prentice Hall of India, 1985.
4. Robert D Cook, David S Malkus, Michael E Plesha, 'Concepts and Applications of Finite Element Analysis', 4th edition, John Wiley and Sons, Inc., 2003.
5. Larry J Segerlind, 'Applied Finite Element Analysis', Second Edition, John Wiley and Sons, Inc. 1984.

Course Outcome:
Apply knowledge of finite element method for understanding, formulating and solving engineering problems.
Analysis of structural and thermal systems.
Demonstrate creativeness in designing new systems components and processes in the field of engineering
Identify, analysis, and solve mechanical engineering problems useful to the society.
Work effectively with engineering and science teams as well as with multidisciplinary problems

MATS UNIVERSITY, RAIPUR (C.G.)
SCHOOL OF ENGINEERING & I.T.

Semester : 1st M.Tech
Branch : Turbomachinery
Subject : Advance Heat Transfer

Code : ME 112

Course Objectives:
To provide a fundamental understanding of the principles of heat transfer due to conduction, convection and radiation.
To achieve an understanding of the basic concepts of phase change processes.
To understand the principles of mass transfer.
To learn about the design of heat exchangers.

UNIT-I FUNDAMENTALS: Modes of heat transfer: Conduction – Convection – Radiation.

UNIT II HEAT CONDUCTION: Factors affecting thermal conductivity of solids, liquids & gases, General three-dimensional heat conduction equation in Cartesian, cylindrical & spherical coordinates, Initial condition and various boundary conditions. Heat source systems, Critical thickness of insulation. Different types of fins & their analysis, Two-dimensional steady state conduction. Electrical analogy, graphical & numerical methods. Transient heat conduction with & without temperature gradients within the system, Heat flow in Semi -infinite solids. Application of heisler charts.

UNIT-III FREE AND FORCED CONVECTION: Convection fundamentals: Basic equations, Boundary layer concept, Dimensional analysis.**Free & Forced convection**: Similarity & Simulation of convection heat transfer, Boundary layer theory. Turbulent flow heat transfer. Analogy between momentum & heat transfer. Heat transfer with liquid metals. Heat transfer in high velocity flow. Recent development in theory of turbulent heat transfer. Natural convection under different situations. Empirical relations in convection heat transfer.

UNIT-IV BOILING AND CONDENSATION: Boiling & Condensation, Regimes of boiling heat transfer, Heat transfer in condensation, Drop wise & film condensation, Empirical equations.

UNIT-V RADIATIVE HEAT TRANSFER : Radiation heat transfer properties. Laws of thermal radiation. Shape factors. Radiation heat transfer between black, diffuse & gray surface. Electric network method of solving radiation problems. Radiosity approach. Gas emission & absorption, Bulk Radiations.

REFERENCES:

1. S. P. Sukhatme, “Heat Transfer”, University Press (India), 1996.

2. J. P. Holman, “Heat Transfer”, McGraw Hill Book. Co, 2002.

3. Eckert and Drake, “Heat and Mass Transfer”, McGraw Hill, 1960.

4. Oziski, M. N. “Heat Transfer – A Basic Approach”, McGraw Hill, book comp., N. Y., 1985.

5. Roshenow, W., Hartnett, J., Ganic, P., “Hand Book of Heat Transfer, Vol -1 & Vol- 2, McGraw Hill N. Y. 1980.

6. Incropera & Dewitt, “Fundamentals of Heat and Mass Transfer”, John Wiley 1996.

Course Outcome:
Apply knowledge of heat transfer for understanding, formulating and solving engineering problems.
Acquire knowledge and hands-on competence in applying the concepts of heat and mass transfer in the design and development of mechanical systems.
Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular
Identify, analysis, and solve mechanical engineering problems useful to the society.
Work effectively with engineering and science teams as well as with multidisciplinary designs.

MATS UNIVERSITY, RAIPUR (C.G.)
SCHOOL OF ENGINEERING & I.T.

Semester : 1st M.Tech
Branch : Turbomachinery
Subject : Experimental Techniques
Code : ME113

Course Objectives:
This course aims to introduce students to use advanced quantitative methods and techniques for effective decisions–making; model formulation and applications that are used in solving business decision problems.

UNIT-I

Basic concepts of Measurement, Statistical Analysis of Experimental Data Method of Least Squares, Uncertainty Analysis.

UNIT-II

Response characteristics of Instruments – 1st & 2nd order instrument. Transducers, Vibration & Noise measurements

UNIT-III

Theory of strain gauges, Advance & Specific measurements –Stress & Strain Measurement by Photo Elastic Bench, Hotwire & Laser Doppler Anemometry.

UNIT-IV

Thermal & Transport property measurement, Thermo gravimetry, Gas Chromatography, Air Pollution & Nuclear radiation measurement.

UNIT-V

NDT, Radiography, Ultrasonography, Wind Tunnel Testing, Data Acquisition System.

REFERENCES:

1. Holman, J.P, “Experimental Methods for Engineers” 5th Ed. McGraw hill International Edition, 1989.

2. Doeblin, E.O., “Measurement System – Application and Design – McGraw Hill International Ed., 1990.

3. Eckman, D.P. “Industrial Instrumentation”, Wiley Eastern Ltd., New Delhi, 1990.

4. Hale, J. and Kocak, H., “Dynamics and Bifurcations”, Springer-Verlag, N.Y. 1991.

5. Strogatz, S.H., “Nonlinear Dynamics and Chaos”, Addison Wesley, Massachusetts, 1995.

6. Helfrack, A.D. and Cooper, W.D., “Modern Electronic Instrumentation & Measurement Techniques”, Prentice Hall of India Pvt. Ltd., New Delhi -2001.

Course Objectives:
Ability to understand and analyze managerial problems in industry so that they are able to use resources (capitals, materials, staffing, and machines) more effectively.
Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry.
Skills in the use of Operations Research approaches and computer tools in solving real problems in industry.

MATS UNIVERSITY, RAIPUR

SCHOOL OF ENGINEERING & I.T.

Semester: 1st M. Tech Course
Branch :Turbo-Machinery
Subject: Advance Fluid Dynamics
Code: ME 114

Course Objectives:
Obtaining a solid understanding of the fundamentals of Fluid dynamics
The ability to formulate basic equations for Fluid Engineering problems
.The ability to use tables and figures to determine the friction energy loss for various pipes/ducts geometries and fluid engineering applications
The ability to perform dimensional analysis and identify important parameters

UNIT-I

Cartesian Tensors, Basic Concepts: Types of fluids and basic equations of flow, basic concepts in laminar and turbulent flows. Equations Governing Fluid Motion: Navier stokes equations, Boundary layer equations, Exact solutions of N -S equations, Flow between concentric rotating Cylinders, Parallel flow of a powder–law fluid.

UNIT-II

Potential Theory: Kelvin's theorem, source, sink, vortex and doublet, development of complex potentials by super position, Singularities – plane flow past bodies – Dirchlet theorem - Conformal transformation and thin aerofoil theory.

UNIT-III

Laminar Boundary Layers: Blasius solution, Boundary Layers with non -zero pressure gradient, separation and vortex shedding. Turbulent Flow: Mechanism of turbulence, derivation of governing equations for turbulent flow, K-E model of turbulence, Universal velocity distribution law and friction factor, Kinetic energy of the mean flow and fluctuations, Relaminarization.

UNIT-IV

Experimental Techniques: Pressure tubes, Thermal anemometers, Laser – Doppler anemometers, P-I velocimeter.

UNIT-V

Computational Fluid Dynamics: Philosophy of CFD, Governing equations, thin derivation and physical meaning, mathematical behaviour of P.D.E. and its impact on CFD, Finite difference scheme, Grid generation and transformation, Application to FEM and finite volume method for CFD Problems.

REFERENCES:

1. H. Schlichting, “Boundary layer Theory”, McGraw Hill, 1987.

2. Jo. Hinze, “Turbulence”, McGraw Hill, 1975.

3. P. Bradshaw, “Turbulence”, Springer-Verleg, 1976.

4. Anderson D. A., Tannhill, I.C., and Pletcher, R.H., “Computational Fluid Mechanics and Heat Transfer,” Hemisphere Publ. Co., N.Y. 1984.

5. K. Murlishar and T. Sunderajan, “Computational Fluid Flow and Heat Transfer,” Narosa Pub. House, New Delhi, 1997.

6. Anderson, John, D., “Computational Fluid Dynamics,” McGraw Hill, N.Y., 1995.

7. Fox, R. W. and McDonald, A. T., “Introduction to fluid Mechanics,” John, Wiley & Sons, N. Y., 1985.

8. Shapiro, A.H., “The Dynamics and Thermodynamics of Compressible Fluid Flow,” The Ronald Press Company, N.Y., 1954.

9. Tennekes, H. and Lumley, J. L., “A First Course in Turbulence,” M.I.T., Press, Cambridge, M.A. 1972.

10. Streeter, V.L. and Wylie, E.B., “Fluid Mechanics,” McGraw Hill Int. Student Edition, 1979.

11. Zucrow, M. “Gas Dynamics,” John Wiley & Sons, 1976.

Course Outcomes:
.Apply knowledge of Fluid dynamics formulating and solving engineering problems.
.Acquire knowledge of fluid dynamics for the design and development of mechanical systems.
.Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular.
Identify, analysis, and solve mechanical engineering problems useful to the society.
.Work effectively with engineering and science teams as well as with multidisciplinary designs.
Skill fully use modern engineering tools and techniques for mechanical engineering design, analysis and application.
.Develop fundamentals to continue the study of the advance subject fluid machinery, Heat and mass transfer etc.

MATS UNIVERSITY, RAIPUR

SCHOOL OF ENGINEERING & I.T.

Semester	:	1st M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	Gas Turbine Cycles and Jet Propulsion
Total Theory Periods	:	45
Total Tutorial Periods	:	15
Code	:	ME 115

Course Objectives
To study classifications of gas turbine cycle
To study construction and working of different jet propulsion
To acquire the knowledge and skill of analyzing Gas Turbine Cycles and Jet Propulsion

UNIT-I

Open cycle, Twin Shaft Arrangement, Multi Spool Arrangement of Gas Turbines, Closed Cycles, Air Craft Propulsion, and Environmental Issues.

UNIT-II

Ideal Cycles, Combustion and Combustion Chambers, Component Losses, performance calculations Comparison with practical Cycles.

UNIT-III

Criteria for performance, Intake & Propelling Nozzle efficiency, Simple Turbo –Jet Cycles, Turbo Fan Engine, Turbo -prop engines, Turbo Shaft engines, Thrust augmentation.

UNIT-IV

Prediction of Performance of Simple Gas Turbine, Methods for Improving Part–load Performance, Matching Procedure for Turbo -fan Engines Transient behaviour of Gas Turbines, Performance Deterioration and principle of control system.

UNIT-V

Rocket Propulsion-Classification, Operation, Performance, Ramjet Engines.

REFERENCES:

1. Saravanamootoo, H.I.H., & Rogers, G.F.C., "Gas Turbine Theory" Person Education (Singapore) Pvt. Ltd.., Indian Branch, New Delhi 2001.

2. Somasundaram S.L., "Gas Dynamics & Jet Propulsion", New Age International (P) Ltd., New Delhi, 1996

3. Barlit V., "Lecture Notes Delivered at Bharat Heavy Electricals Ltd.", Vol.I & Vol.II, 1966.

4. Canady G., "Theory of Turbomachines" McGraw Hill Book Co., N.Y. 1964

5. Jain J.K., "Gas Turbine Theory & Jet Propulsion" Khanna Publisher, Delhi 1995.

6. Yahya S.M., "Gas Turbine Theory" Ganeshan, V., "Gas Turbine", Tata McGraw Hill, 1999.

Course Outcomes:
Apply knowledge of turbo machinery for understanding, formulating and solving engineering problems.
Acquire knowledge and hands-on competence in the design and development of mechanical systems.
Identify, analysis, and solve mechanical engineering problems useful to the society.
Work effectively with engineering and science teams as well as with multidisciplinary designs.

MATS UNIVERSITY, RAIPUR

SCHOOL OF ENGINEERING & I.T.

Semester	:	1st M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	CAD/CAE Laboratory
Code	:	ME 116

Course Objective:
To introduce the student to be familiar with CAD/ CAE terminology & its capabilities.
To become familiar with CAD/ CAE software, Graphical user interface & basic tools.
To recognize geometric and graphical elements of engineering design problems
To apply a "hands-on" understanding of the basic concepts of computer-aided manufacturing and prototyping through group and individual projects
To study Basic features of CAE so as to be capable of accepting professional responsibilities and to understand the associatively between design and manufacturing.
Integrate the CAD system and the CAE system by using the CAD system for modeling design information and converting the CAD model into a CAE model for modeling the manufacturing information.

LIST OF EXPERIMENTS

1. Scaling, rotation, translation, editing, dimensioning –Typical CAD command structure.
2. Wire frame modeling –surface modeling
3. Solid Modeling
4. Advanced modeling
5. CFD/FEM Fundamentals
6. Flow Simulation over a Symmetrical Airfoil using CFD
7. Flow Simulation over a Cambered Airfoil using CFD
8. Flow Simulation over a Turbine Blade (static analysis) using CFD
9. Stress Analysis of a Turbine Blade (Rotation only and no pressure loads)
10. Stress Analysis of any Turbine Component

LIST OF EQUIPMENTS

1. Computers with minimum 1 GB RAM, Pentium-IV Processor,
2. Pro-E -Wildfire,
3. AutoCAD(latest),
4. CATIA,
5. SOLIDWORKS
6. ANSYS- 12 with Fluent and CFX
7. NASTRAN
8. UPS 10 KVa 3-Phase

Course Outcome:
Understand the various CAD/ CAE and CNC processes.
Generate and verify the tool path and NC programs for milling and drilling manufacturing processes.
Recognize various types of Curves, surface and Solid and their application as used in geometric modeling.
Appreciate the concept of parametric modeling which is the mainstay of most of the 3D modeling system.
Write and prove sample part programs for CNC machining centres in planar milling operations using the word address format.
Understand the needs of master production schedule and methods to develop it.
Plan and execute the production activity control, which actually deals with operations in the shop floor.
Skill fully uses modern engineering tools and techniques for mechanical engineering design, analysis and application.

MATS UNIVERSITY, RAIPUR

SCHOOL OF ENGINEERING & I.T.

Semester	:	1st M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	Advance Heat Transfer Laboratory
Code	:	ME 117

Course Objectives:
To provide a fundamental understanding of the principles of heat transfer due to conduction, convection and radiation.
To achieve an understanding of the basic concepts of phase change processes.
To understand the principles of mass transfer.
To learn about the design of heat exchangers.

LIST OF EXPERIMENTS

1. To find out the thermal conductivity of a given metallic rod.
2. To study the counter flow and parallel flow heat exchangers and derive the expression for log mean temperature difference and effectiveness.
3. To find out the thermal conductivity of given insulating powder.
4. To find out the thermal emissivity of a given grey body.
5. To study two phase heat transfer unit to observe the boiling phenomenon and to find out critical heat flux for a given wire.
6. To find out the value of Stephen Boltzmann constant and compare the same with the theoretical value.
7. To find out the thermal conductivity of two slab guarded by hot plate method.
8. To find out heat transfer coefficients under different flow conditions and compare with the theoretical value.
9. To find out the efficiency of pin fin in natural convection conditions.
10. To find out the thermal conductivity of metal by the method of heat transfer in extended surface.

LIST OF EQUIPMENTS

1. Voltmeter,
2. Ammeter,
3. Digital temperature indicator,
4. Voltage regulator,
5. Heating element,
6. Parallel flow and Counter flow Heat Exchanger,
7. Glass beaker,
8. Immersion Heater,
9. Thermocouple,
10. IS: 3346- 1966 Apparatus,
11. Thermometers,
12. Brass fin

Course Outcome:
Apply knowledge of heat transfer for understanding, formulating and solving engineering problems.
Acquire knowledge and hands-on competence in applying the concepts of heat and mass transfer in the design and development of mechanical systems.
Demonstrate creativeness in designing new systems components and processes in the field of engineering in general and mechanical engineering in particular
Identify, analysis, and solve mechanical engineering problems useful to the society.
Work effectively with engineering and science teams as well as with multidisciplinary designs

MATS UNIVERSITY, RAIPUR

SCHOOL OF ENGINEERING & I.T.

Semester	:	1st M. Tech Course
Branch	:	Turbo-Machinery
Subject	:	Gas Turbine and Jet Propulsion Laboratory
Code	:	ME 118

LIST OF EXPERIMENTS

1. To study about the operation of Open cycle and Closed cycle Gas Turbine Engines.
2. To estimate the performance of Gas Turbine Engine.
3. To study about the construction and operation of Turbojet Engine.
4. To study about the construction and operation of Turbofan Engine.
5. To study about the construction and operation of Ramjet Engine.
7. To estimate the performance of Combustion Chamber of Gas Turbine Engine.
8. To estimate the performance of De-Laval Nozzle.
9. To study about the construction and operation of Rocket Engines.
10. To study about the matching procedure of Turbofan Engines.
11. Part-load Performance estimation of Gas Turbine.

LIST OF EQUIPMENTS

1. Gas Turbine Performance Test Setup
2. Combustion Chamber Test Setup
3. De-Laval Nozzle Test Setup.
4. Gas Turbine Part-load Performance Test Setup

Course Outcomes:
Apply knowledge of turbo machinery for understanding, formulating and solving engineering problems.
Acquire knowledge and hands-on competence in the design and development of mechanical systems.
Identify, analysis, and solve mechanical engineering problems useful to the society.
Work effectively with engineering and science teams as well as with multidisciplinary designs.