M Tech in Mechanical Engineering with specialization in Thermal and Design Engineering

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL					
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*	L	T	P	CREDITS
MTME201	DS	Design of Thermal Systems	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs)

The basic objective of the subject is to have goal of achieving a workable system and of designing an optimum system. The possibility of optimization represents one of the few facets of this subject. Pre requisites: Thermodynamics, Heat & Mass Transfer.

Course Outcomes (COs):

1. To learn basic principles underlying piping, pumping, heat exchangers; modeling and optimization in design of thermal systems.
2. To develop representational modes of real processes and systems.
3. To develop thermo economic optimization concerning design of thermal systems.

Syllabus

Unit- I

Designing a workable system and its economics: steps in arriving at a workable system, creativity in concept selection, design of any thermal process plant, preliminaries to the study of optimization

Unit- II

Dynamic behavior of thermal systems: Dynamic analysis, one dynamic element in a steady state simulation, laplace transformers, inversion of laplace transforms, feedback control loops, time constants blocks, cascaded time constant blocks, stability analysis.

Unit – III

Modeling thermal equipment: Using physical insight, selecting vs simulating a heat exchanger, evaporators and condensers, condensation of a binary mixture, overview of search methods, assessment of single variable searches.

Unit-IV

System simulation: Description of system simulation uses of simulation, information flow diagrams, sequential and simultaneous calculations, Taylor series expansion, newton Raphson method with multiple equations.

Unit- V

Optimization: Levels of optimization, mathematical representation of optimization problems, linear programming, setting up the mathematical statement, calculus methods of optimization, expansion of lagrange multiplier equations, unconstrained optimization.

References

1. *Cengel YA., Heat Transfer-A Practical Approach, Tata McGraw Hill, New Delhi 2e,2002. [2]*
2. *Stoecker, WF. Design of Thermal Systems, McGraw Hill International Editions, New Delhi, 2007 [3] Woodson, TT. Introduction to Engineering Design, McGraw Hill, New York, 1996. [4] Rudd, DF. Strategy of Process Design, McGraw Hill, New York, 1996.*

List of experiments

1. Compressibility factor measurement of different real gases.
2. Dryness fraction estimation of steam.
3. Flame propagation analysis of gaseous fuels.
4. Performance test and analysis of exhaust gases of an I.C. Engine.
5. Heat Balance sheet, Volumetric Efficiency and air fuel ratio estimation of an I.C. Engine.
6. COP estimation of vapour compression refrigeration test.
7. Performance analysis of Air conditioning unit.
8. Performance analysis of heat pipe.
9. Solar Flat Plate Collector
10. Evacuative tube concentrator

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
MTME202	DS	Design of IC Engine & Components	60	20	20	30	20	3	1	2	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

The course should enable the students to (A)Know about various types of materials, properties of materials and various applications of the Materials, and computer aided application. (B)Know about the fits, clearance and tolerances concepts, also the design of the helical springs. (C) Know about design procedure to design piston and its parts, cylinder and cylinder block, Lubrication of piston assembly. (D)Understand the designing the parts of connecting rod and crankshaft, know about the materials of connecting rod and crankshaft, and also know about the balancing of crankshaft. (E)Understand the design aspects of Inlet and exhaust valves, valve mechanism, and also the Materials for the valves.

Course Outcomes (COs):

The students should be able to:

1. Know about the types of materials and material properties, Application of the materials, CAD application in the Automobile industry and Differentiate between the concepts of Fits, Clearance and Tolerance.
2. Design the helical springs and its application. The cylinder block and cylinder parts based on the engine specification of and also based on the engine application and the piston and its parts based on the engine specification of and also based on the engine application.
3. Design the connecting rod and its parts based on the engine specification of and also based on the engine application. The crankshaft and its parts based on the engine specification of and also based on the engine application also with the balancing weight of the crankshaft.
4. Design the valves and its mechanism for both the inlet and exhaust valve based on the engine specification of and also based on the engine application.
5. Identify the different types of materials used for the manufacturing of the valve and its components.

Syllabus

Unit-I

General considerations in engine design: Principle of similitude, Choice of cycle, Speed, Fuel, Bore and Stroke, Cylinder arrangement, choice of material, Stress and Fatigue considerations, Design for manufacture, Factors for NHV and Control.

Unit – II

Design of major components: Piston system, Connecting rod assembly, Crankshaft system, Valve gearing, Stress analyses.

Unit-III

Design of other components: Inlet and exhaust manifolds, Cylinder block, Cylinder liner, Cylinder head, Crankcase, Engine foundations and mountings, Gaskets, Bearings, Flywheel. Turbocharger, Supercharger, computer controlled fuel injection system.

Unit-IV

Design of two-stroke engines: Arrangement and sizing of ports, Piston assembly, Intake and exhaust system, Scavenging, application to automotive gasoline and marine diesel engines.

Unit-V

Concepts of computer aided design: Preparation of working drawings of designed components using CAD system.

References

1. *Gordon Blair, Basic design of Two-stroke Engines, S.A.E., 1992.*
2. *Gordon Blair, Advanced Concepts of Two-stroke Engines, S.A.E., 1990.*
3. *Pounder, C.C., Marine Diesel Engines, Butterworth's, 1981.*
4. *A. Kolchin and V. Demidov, Internal Combustion Engine Design, MIR Publishers, Moscow, 1984.*
5. *Gordon Blair, Design and Simulation of Four-Stroke Engines, Society of Automotive Engineers, Inc., USA, 1999.*
6. *D.E. Winterbone and R.J. Pearson, Design Techniques for Engine Manifolds, Wave action methods for I.C. Engines, Professional Engineering Publishing Ltd., UK, 2000.*
7. *John Fenton (Editor), Gasoline Engine Analysis for Computer Aided Design, Mechanical Engineering Publishing Ltd., UK, 1986.*
8. *Rodica Baranescu and Bernard Challen (Editors), Diesel Engine Reference Book, Second Edition, Society of Automotive Engineers, Inc., USA, 1999.*
9. *SAE Special Publication SP-700, Adiabatic Engines and Systems, Society of Automotive Engineers, Inc., USA, 1987.*

List of experiments

Design of automobile components:

1. Cylinder
2. Piston
3. Connecting rod.
4. Valves

5. Crank shaft
6. Cam shaft
7. Analysis of compression and expansion processes.

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
MTME203	DS	Dynamics and Mechanism Design	60	20	20	30	20	3	1	2	5

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

(A)The course should enable the students to(B)To understand the method of static force analysis and dynamic force analysis of mechanism(C)To study the undesirable effects of unbalances in rotors and engines. (D)To understand the concept of vibratory systems and their analysis to understand the principles of governors and gyroscopes.

Course Outcomes (COs):

The students should be able to:

1. Students will demonstrate the ability to synthesis, both graphically and analytically, multilink mechanisms.
2. Students will demonstrate the ability to perform mechanism analyses to find the position, velocity, acceleration, and dynamics of multi-bar mechanisms.
3. Students will demonstrate the ability analyze gear trains.

Syllabus

Unit - I

Angular Motion: Gyroscopes - effect of precession - motion on the stability of moving vehicles such as motorcycle - motorcar - aero planes and ships. Static and Dynamic Force Analysis of planar mechanisms.

Unit - II

Friction: Inclined plane - Friction of screw and nuts - Pivots and collars - uniform pressure, uniform wear - friction circle and friction axis: lubricated surfaces - boundary friction - film lubrication, Clutches, Single plate, multi plate, cone clutch, centrifugal clutches**.**
Brakes and Dynamometers: Simple block brake - Internal expanding brake band brake of vehicle. Dynamometers - absorption and transmission types, General description and methods of operation.

Unit - III

Turning Moment Diagram and Flywheels: Turning moment- Inertia torque- connecting rod angular velocity and acceleration-crank effort and torque diagrams-fluctuation of energy - flywheels and them Governors: Watt, Porter and Propel governors- Spring loaded governors - Hartwell and Hurting with auxiliary springs- Sensitiveness, isochronism's and hunting- effort and power of the governors.

Unit - IV

Static and dynamic balancing – Balancing of rotating Masses-Balancing a single cylinder engine–Balancing of Multicylinder inline, V-Engines-Partial balancing in engines Balancing of linkages-Blancing machines Field balancing of discs & rotors

Unit - V

Response of one-degree freedom systems to periodic forcing- Harmonic disturbances- Disturbance caused by unbalance- Support motion-transmissibility- Vibration isolation vibration measurement.

References

1. *Theory of Machines / S. S. Rattan / Mc Graw Hill.*
2. *Theory of Mechanism and Machines / Jagdish Lal / Metropolitan Book Company.*
3. *Theory of Machines / Shigley / Mc Graw Hill Publishers.*
4. *Theory of Machines / Thomas Bevan / Pearson.*
5. *Theory of Machines / R. K. Bansal / Lakshmi Publications / 5th Edition*
6. *Mechanism and Machine Theory / JS Rao and RV Duggipati / New Age.*
7. *Theory of Machines / Sadhu Singh / Pearson / 3rd Edition.*
8. *Mechanism and Machine Theory / Ashok G. Ambekar / PHI / Eastern Economy Edition.*

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSTMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSTMENT*				
MTME214	DS	Incompressible and Compressible Flows	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives:

To impart knowledge of (A)various basic principles and equations of fluid flow, exact and approximate solutions of Navier-Stokes equations under various flow conditions and introducing concepts in compressible flow normal shock, oblique shock and Fanon flow and Rayleigh Flow

Course Outcomes (COs):

The student will be able to

1. Ascertain basic concepts in the fluid flow.
2. Analyze both incompressible and compressible flow conditions.
3. Analyze practical problem in fluid flow.
4. Apply the concepts in the analysis of the fluid flow problems.
5. Capable of using the theories in the real life situation and take appropriate decisions with regards to design of various fluid handling devices.
6. Understand the performance of fluid flow devices in laminar and turbulent flow.
7. Design compressible flow components used in Turbo Machines and Air-Conditioning.

Syllabus

Unit-I

Introduction: Introduction to Fluid Mechanics, Properties of Fluids. Fluid **Statics**: Fluid Statics, Fundamental Equations-Applications of Fundamental Equations, Relative Motion of Liquids Kinematics of Fluids, **Kinematics of Fluids-** Review of basics, Velocity potential, Stream function and Vorticity. **Theory of Stress and Rate of Strain:** General theory of Stress and Rate of Strain Fundamental Equations, Integral form Fundamental Equations, Reynolds Transport Theorem, Applications of the Integral Form of Equations-Numerical.

Unit-II

Fundamental Equations in Differential Form: Equations in Differential Form, One-dimensional Inviscid Incompressible Flow, Euler's Equation and Bernoulli's Equation, Applications of the Bernoulli's Equations-Numerical. **Two and Three – dimensional Inviscid Incompressible Flow:** Two and Three – dimensional Inviscid Incompressible Flow, Laminar Flow, Flow between Parallel Flat plates, Steady Flows in Pipes, Applications of Laminar Flow-Numericals.

Unit-III

The Laminar Boundary layer: The Laminar Boundary layer, Prandtl Boundary Layer Equations, The Boundary layer along a Flat Plate, Solution to the Boundary Layer Equations,
Momentum Integral Equation, Separation of Boundary Layer and Control-Numericals
Turbulent Flow: Introduction to Turbulent Flow, Modified N-S Equations-Semi, empirical Theories, Turbulent Boundary Layer, Numericals
Dimensional Analysis: Flow over a bluff body, Lift and Drag, Dimensional Analysis and Similitude.

Unit-IV

Introduction to Compressible Flow: Review of Fundamentals Stagnation Properties, Relations and Tables, Numericals **Wave Motion:** Propagation of Motion in Compressible Fluids, Mach number and Mach Cone, Numericals, Isentropic Flow**. Isentropic Flow:** Relations, Flow through Nozzles and Diffusers, Isentropic Flow Relations and Tables, Numericals

Unit-V

Flow across Normal Shock and Oblique Shock: Basic Equations, Normal Shock, Prandtl-Meyer Equation, Oblique Shock-Property variation, Relations and Tables, Numericals.
Flow through a constant area duct with Friction: Flow through a constant area duct with Friction Fanon, Line Fanon Flow, Variation of Properties, Relations and Tables, Numericals. Flow through a constant area duct with Heat Transfer, Flow through a constant area duct with Heat Transfer Rayleigh Line, Rayleigh Flow

References

1. *S.W. Yuan., Foundations of Fluid Mechanics, Prentice Hall of India, 2000*
2. *2. S.M. Yahiya, Fundamentals of Compressible Flow, with Aircraft and Rocket Propulsion, 4th edition, New Age techno, 2010*
3. *Schlichting, H., Boundary Layer Theory, 8th edition, Springer, 2004.*
4. *White F.M., Viscous Fluid Flow, 3rd edition, Tata mcgraw Hill Book Company, 2011.*

SUBJECT CODE	Category	SUBJECT NAME	TEACHING & EVALUATION SCHEME								
			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
MTME224	DS	Measurement in Thermal Engineering	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

The objective of the course is to make the students (A)Introduce to analyze experimental error, static and dynamic characteristics of instruments. (B)Learn the working of various measuring instruments used in the field of thermal engineering (C)Learn the measurement of properties like thermal conductivity of solids, liquids and gases (D)Learn the measurement of transport properties like diffusion, convective heat transfer. (E)Introduce to electronic control systems associated with automatically controlling the measuring parameters. (F)Introduce to applications and important features of various measuring instruments

Course Outcomes (COs):

After completion of this course the students will be able to:

1. Use appropriate instrument for measurement of specific parameter.
2. Analyze experimental error, Static and Dynamic characteristics of instruments.
3. Use appropriate instrument measurement of transport properties.
4. Practically apply the principles of measurement to engineering applications / projects.

Syllabus

Unit -I

Instrument classification, static and dynamic characteristics of instruments, experimental error analysis, systematic and random errors, statistical analysis, uncertainty, reliability of instruments,
Variable resistance transducers, capacitive transducers, piezoelectric transducers, photoconductive transducers, photovoltaic cells, ionization transducers, Hall effect transducers.

Unit -II

Dynamic response considerations, Bridgman gauge, McLeod gauge, Pirani thermal conductivity gauge, Knudsen gauge, Alpha Tron.

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Unit -III
Flow measurement by drag effects; hot-wire anemometers, magnetic flow meters, flow visualization methods, interferometer, Laser Doppler anemometer.
Temperature measurement by mechanical effect, temperature measurement by radiation, transient response of thermal systems, thermocouple compensation, temperature measurements in high- speed flow.

Unit -IV
Thermal conductivity measurement of solids, liquids, and gases, measurement of gas diffusion, convection heat transfer measurements, humidity measurements, heat-flux meters.
Detection of thermal radiation, measurement of emissivity, reflectivity and transmissivity, solar radiation measurement.

Unit -V
Review of open and closed loop control systems and servo mechanisms, transfer functions of Mechanical Systems, input and output systems.

References
1. *Holman, J.P., "Experimental methods for engineers", Tata McGraw-Hill, 7th Edition, 2007.*
2. *Prebrashensky. V., "Measurement and Instrumentation in Heat Engineering", Vol.1, MIR Publishers, 1980.*
3. *Raman, C.S. Sharma, G.R., Mani, V.S.V., "Instrumentation Devices and Systems", 2nd Edition, Tata McGraw-Hill., 2001.*
4. *Morris. A.S, "Principles of Measurements and Instrumentation",3rd Edition, Butterworth-Heinemann, 2001.*
5. *Beckwith &Buck: Mechanical Measurements*
6. *Control Systems, Principles & Design, 2nd Edition – M. Gopal – TMH.*

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
MTME215	DS	Advance Heat and Mass Transfer	60	20	20	0	0	3	1	0	4

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

(A)The basic objective of the subject is to have goal of achieving a workable system and of designing an optimum system. (B)The possibility of optimization represents one of the few facets of this subject. Pre requisites: Thermodynamics, Heat & Mass Transfer.

Course Outcomes (COs):

To learn basic principles and mode of transfer of heat energy by convection, conduction and radiation. To learn basic Application of empirical relations to variation geometries for laminar and turbulent flows. Each student understands the physical mechanisms involved in radiation heat and mass transfer

Syllabus

Unit - I

Introduction to different modes of heat transfer: Conduction: General heat Conduction equation-initial and boundary conditions. Transient heat conduction: Lumped system analysis- Heisler charts-semi-infinite solid-use of shape factors in conduction-2D transient heat conduction-product solutions.

Unit -II

Finite difference methods for conduction: 1D& 2D steady state and simple transient heat conduction problems-implicit and explicit methods. Forced Convection: Equations of fluid flow-concepts of continuity, momentum equations-derivation of energy equation-methods to determine heat transfer coefficient: Analytical methods-dimensional analysis and concept of exact solution. Approximate method-integral analysis.

Unit - III

External flows: Flow over a flat plate: integral method for laminar heat transfer coefficient for

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different velocity and temperature profiles. Application of empirical relations to variation geometries for laminar and turbulent flows. Internal flows: Fully developed flow: integral analysis for laminar heat transfer coefficient-types of flow-constant wall temperature and constant heat flux boundary conditions-hydrodynamic & thermal entry lengths; use of empirical correlations.

Unit -IV

Convection: Thermal boundary layers - Momentum and energy equations -Internal and external flows- Forced convection over cylinders, spheres and bank of tubes.

Unit - V

Radiation: Recapitulation of fundamentals of radiative heat transfer, radiative properties of surfaces, methods of estimating configuration factors, heat exchange between diffusively emitting and diffusively reflecting surfaces. Radiant energy transfers through absorbing, emitting and scattering media. Combined conduction and radiation systems: fins, Introduction to solar radiation in earth 's atmosphere.

References

1. *V.S Arpaci – Conduction Heat Transfer E.M Sparrow,*
2. *R.D Cess – Radiation Heat Transfer*
3. *Engg. Heat & Mass Transfer/ Sarit K. Das/Dhanpat Rai*
4. *Heat Transfer/ P.K. Nag /TMH*
5. *Heat Transfer/RK Rajput/S.Chand*
6. *Introduction to Heat Transfer/SK Som/PHI*
7. *Engineering Heat & Mass Transfer/Mahesh Rathore/Lakshmi Publications*
8. *Heat Transfer / Necati Ozisik / TMH*
9. *Heat Transfer / Nellis & Klein / Cambridge University Press / 2012.*
10. *Heat Transfer/ P.S. Ghoshdastidar/ Oxford Press*

List of Experiments

1. To determine following parameters for composite wall structure, (a) total thermal resistance, (b) thermal conductivity (c) to plot temperature gradient along the composite wall structure.
2. To determine the value of Nusselt number and convective heat transfer coefficient for ice plate loosing heat by natural convection experimentally and by using empirical correlation.
3. To determine surface heat transfer coefficient for vertical cylinder / tube in natural convention mode.
4. To determination of Emissivity of nonblack surface. And study of variation of Emissivity of test plate with respect to absolute temperature.
5. To study the unsteady state of heat transfer.
6. To study of temperature distribution along the length of simple pin fin in both natural & forced convection. Comparison of theoretical temperature distribution with experimentally obtained distribution. Comparison of performance of fins of various materials supplied.

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO TERM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
MTME225	DS	Gas Turbines & Jet Propulsion	60	20	20	0	0	3	1	0	4

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Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

(A)To understand the basic concepts and importance of gas dynamics. (B)To understand the phenomena of various flows such as Shock, Fanon and Rayleigh flow. (C)To understand the type of flow takes place in flow and non-flow system. (D)To understand various terms such as Mach no., Subsonic, Sonic and Supersonic flow. (E)To understand the thrust equation and its application in aircraft and rocket propulsion.

Syllabus

Unit – I

Basic Concepts of Gas Dynamics: Terms related to gas dynamics, Energy Equation for flow process, Various flow regions, stagnation state, velocity of sound, Mach number., Subsonic, Sonic and Supersonic Flow, Critical Mach number, Croce Number, Mach cone, effect of Mach number on compressibility, T-S and h-s diagram for diffuser and nozzle process.

Unit – II

Oblique Shock Waves: Relations and reflections of oblique shock waves, interaction of oblique shock waves, conical shock waves, Expansion waves, Prandtl-Meyer flow, reflection of expansion waves, flow over bodies involving shock and expansion waves, Variable area flow and its equations, characteristics of Nozzle operation, Supersonic Diffusers-Convergent and Divergent. Flow in constant area duct. The fanon line.

Unit – III

Flow with Heat addition or removal:1-D flow in constant area duct, variable area flow with addition of heat, Generalized Quasi 1-D flow, one-dimensional constant area flow with friction and heat exchange, governing equations for 1-D flow, Two-Dimensional Compressible Flow: Governing equations, velocity potential, linearized subsonic flow, linearized supersonic flow.

Unit - IV

Propulsion: Air craft propulsion, jet engine and its types, flow of energy through jet engines, thrust, power and propulsive efficiency of jet engines. Turbojet components such as diffuser, compressor, combustion chamber, turbines, exhaust systems. Jet Engine-Performance, turbo prop engines, ram jet and pulse jet engines.

Unit – V

Rocket propulsion: Principle of rocket propulsion, thrust equations, effective jet velocity, performance of rocket engines, specific impulse, thrust application, solid and liquid propellant rockets.

References

1. *Yahiya. S.M., Fundamental of compressible flow with Aircraft and Rocket propulsion", New Age International (p) Ltd., New Delhi, 2005.*
2. *Ganesan. V., "Gas Turbines", Tata McGraw-Hill, New Delhi, 1999*
3. *Patrich.H. Oosthvizen, William E. Carscallen, "Compressible fluid flow", McGraw-Hill, 1997.*
4. *Rathakrishnan. E., "Gas Dynamics", Prentice Hall of India, New Delhi, 2001*
5. *Anderson, D. John Jr., 'Introduction to Flights', Mc Graw Hill, ISE, 2004*
6. *Dr. Somasundaram S.L., 'Gas Dynamics and Jet Propulsion', Newnes – Butterworths & Co Publishers Ltd 1999*
7. *Patrich.H. Oosthvizen, William E. Carscallen, "Compressible fluid flow", McGraw-Hill, 1997*

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			THEORY			PRACTICAL		L	T	P	CREDITS
			END SEM UNIVERSITY EXAM	TWO RM EXAM	TEACHER ASSESSMENT*	END SEM UNIVERSITY EXAM	TEACHER ASSESSMENT*				
MTME206	DS	Material Behavior & Vibration	0	0	0	30	20	0	0	4	2

Legends: **L** - Lecture; **T** - Tutorial/Teacher Guided Student Activity; **P** – Practical; C - Credit;
Teacher Assessment shall be based following components: Quiz/Assignment/ Project/Participation in Class, given that no component shall exceed more than 20 marks.

Course Educational Objectives (CEOs):

(A)Summarize significance of material science and its role in manufacturing. (B)To provide methods of calculating safe rotating speed range to avoid whirling.

Course Outcomes (COs):

1. Classify different engineering material (plastics, composites, smart materials and nanomaterials).
2. Ability to analyze the various properties and manufacturing techniques of plastics materials.
3. Ability of estimation of factor of safety of different designing materials.
4. Ability to use nanomaterials for linear and nanotechnology vibratory systems.
5. General notion on frequency and time response of vibratory systems.

Syllabus

Unit-I

Introduction: Modern materials in design- plastics, composites, smart materials and nanomaterials, Weight reduction using plastics and composites, Properties and uses of plastics, composites, smart materials and nanomaterials in the design of mechanical equipment's. Estimation of factor of safety in design

Unit-II

Design of Plastic Components: Analysis of various properties for plastic components, manufacturing techniques of plastics, Various design considerations for plastic components, Applications of plastics in design of mechanical equipment's, Mechanical properties of glass filled –polyphenylene, glass filled -polyethylene and glass filled-polyurethane.

Unit-III

Nanomaterials: Nanotechnology, Nanoscale, Design applications, Nanotubes, Nano-sized particles in composites, Fabrication of Nano-sized particles, Nano devices.

Unit-IV

Determination of Natural Frequencies Approximate methods of determining fundamental frequencies: Dunkley's lower bound approximation and Rayleigh's Method. Stools Method. The Hollers Method. The Method of Matrix Iteration, Envelop Analysis.

Unit-V

Systems with Multi-degree of Freedom and Continuous Systems. Equations of motion. The Matrix method: Eigen values and Eigen vectors. Vibration of Strings. Longitudinal vibrations of bars. Torsional vibrations of Circular Members. Transverse Vibrations of Beams.

References

1. *Composite manufacturing technology by A.G. Bratukhin and V.S. Bogolyubov, Chapman &Hall publication.*
2. *Smart Materials and Structures, M.V. Gandhi and B.S. Thomson, Chapman &Hall.*
3. *Introduction to Nanotechnology, Charles P Poole and Frank J. Owens, Wiley-Inderscience,2003*
4. *Ambekar A. G., Mechanical Vibrations and Noise Engineering, Prentice Hall of India Pvt. Ltd.,2006.*
5. *G. K. Grover, Mechanical Vibrations, Nem Chand and Bros., Roorkee.*