STUDY & EVALUATION SCHEME

B. TECH. (MECHANICAL ENGINEERING)

(w.e.f. session 2017-18)

3rd Year **6th Semester**

Sl. No	Course Category.	Subject Code	Name of the Subject	Periods				Evaluation Scheme				Subject Total
								Sessional (CA)			End Sem. Exam. (ESE)	
				L	T	P	C	CT	TA	Total		
1.	DC	ME313	Internal Combustion Engines	03	01	-	**04**	25	15	40	60	100
2.	DC	ME314	Fluid Machinery	03	01	-	**04**	25	15	40	60	100
3.	DC	ME315	Refrigeration & Air Conditioning	03	01	-	**04**	25	15	40	60	100
4.	DE		Elective-3	03	01	-	**04**	25	15	40	60	100
5.	DE		Elective-4	03	01	-	**04**	25	15	40	60	100
6.	OE		Open Elective-1	03	01	-	**04**	25	15	40	60	100
7.	DC	ME324	Fluid Machinery Lab	-	-	02	**01**	30	30	60	40	100
8.	DC	ME325	Refrigeration & Air Conditioning Lab	-	-	02	**01**	30	30	60	40	100
			Total	**18**	**06**	**04**	**26**	**210**	**150**	**360**	**440**	800

L – Lecture **T** – Tutorial **P** – Practical **C** – Credits **CT** – Class Test **TA** – Teacher Assessment
Sessional Total (CA) = Class Test + Teacher Assessment
Subject Total = Sessional Total (CA) + End Semester Examination (ESE)
BS – Basic Sciences **DC** – Departmental Core
HM – Humanities **OE** – Open Elective
DE – Departmental Elective **ESA** – Engineering Sciences & Arts (Foundation Course & Engineering Courses)

LIST OF ELECTIVE SUBJECTS

B.TECH. MECHANICAL ENGINEERING

Departmental Elective: DE –3 (6th Semester)

1. ME316 Tribology
2. ME317 Six Sigma Methods, Approach and Applications
3. ME318 Power Plant Engineering
4. ME321 Industrial Ergonomics

Departmental Elective: DE –4 (6th Semester)

1. ME319 Finite Element Method
2. ME320 Advance Machine Design
3 ME322 Applied Elasticity
4 ME323 Advance Fluid Mechanics

INTERNAL COMBUSTION ENGINES
ME313
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT –I

Introduction to I.C. Engines:
Engine classification, Air standard cycles, Otto, Diesel, Striling, Ericsson cycles, Actual cycle analysis, Two and four stroke engines, SI and CI engines, Valve timing diagram, Rotary engines, stratified charge engine. **5**

Fuels:
Fuels for SI and CI engines, important qualities of SI engine fuels, Rating of SI engine fuels, Important qualities of CI engine fuels, Dopes, Additives, Gaseous fuels, LPG, CNG, Biogas, Producer gas, Alternative fuels for IC engines. **3**

UNIT-II

SI Engines:
Carburetion, Mixture requirements, Carburetor types, Theory of carburetor, MPFI. **3**
Combustion in SI engine, Flame speed, Ignition delay, Abnormal combustion and it's control, combustion chamber design for SI engines. **2**
Ignition system requirements, Magneto and battery ignition systems, ignition timing and spark plug. **2**

UNIT-III

CI Engine :
Fuel injection in CI engines, Requirements, Types of injection systems, Fuel pumps, fuel injectors, Injection timings. **4**
Combustion in CI engines, Ignition delay, Knock and it's control, Combustion chamber design of CI engines. **2**
Scavenging in 2-Strock engines, pollution and it's control. **2**

UNIT-IV

Engine Cooling :
Different cooling systems, Radiators and cooling fans. **2**

Lubrication:
Engine friction and lubrication, Principal types of lubrication, Lubricating oils, Crankcase ventilation. **2**

Supercharging:
Effect of altitude on power output, Types of supercharging. **2**

Testing and Performance:
Performance parameters, Basic measurements, Testing of SI and CI engines. **4**

UNIT-V

Compressors :
Classification, Reciprocating compressors, Single and multistage, Intercooling, volumetric efficiency. **3**
Rotary compressors, Classification, Centrifugal compressors, Elementary theory, Vestor diagram efficiencies, Elementary analysis of axial compressors, Surging and stalling, Roots blower, Waned compressor, Performance analysis. **4**

Books:

1. Fundamentals of Internal Combustion Engines: Gill,Smith, Ziurs, Oxford and IBH Publishing.
2. COIC Engines: Rogowsky, International Book Co.
3. A Course in International Combustion Engines: Mathur and Sharma, Dhanpat Rai and Sons.
4. Reciprocating and Rotary Compressors: Chlumsky, SNTI Publications, Czechoslovakia.
5. I.C. Engine Analysis and Practice : E.F. Obert.
6. I.C Engines: Ganeshan, Tata McGraw Hill Publishers.
7. I.C Engines : R.Yadav, Central Publishing House, Allahabad.

Recommended Prerequisite: Applied Thermodynamics (ME202) **Co-requisite:** None

FLUID MACHINERY
ME314
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT –I

Introduction :

Classification of Fluid Machines, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation.

Impact of Jet:

Introduction to hydrodynamic thrust of a jet on a fixed and moving surface (flat and curve), effect of inclination of jet with the surface.

Hydraulic Turbines:

Classification of turbines, Impulse turbines, Constructional details, Velocity triangles, Power and efficiency calculations, governing of pelton wheel. **8**

UNIT-II

Reaction Turbines :

Fransis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitation in turbines, Principles of similarity, Unit and specific speeds, Performance characteristics, Selection of water turbines. **8**

UNIT-III

Centrifugal Pumps;

Classifications of centrifugal pumps, Vector diagram, Work done by impellor, Efficiencies of centrifugal pumps, Specific speed, Model testing, Cavitation and separation, Performance characteristics. **8**

UNIT-IV

Positive Displacement Pumps :

Reciprocating pump theory, Slip and coefficient of discharges, Indicator diagram, Effect and acceleration, Work saved by fitting air vessels, Comparison of centrifugal and reciprocating pumps, positive rotary pumps, Gear and Vane pumps, Performance characteristics. **8**

UNIT-V

Other Machines :

Hydraulic accumulator, Intensifier, Hydraulic press, Lift and Cranes, theory of hydraulic coupling and torque converters, performance characteristics. **8**

Water Lifting Devices:

Hydraulic ram, Jet pumps, Airlift pumps.

Books:

1. Hydraulic Machines: Jagdish Lal, Metropolitan Book Co.
2. Hydraulic Machines: Theory and Design, V.P. Vasandhani, Khanna.
3. Applied Hydraulics : Addison.
4. hydraulic Machines: R.K. Rajput, S. Chand and Co. Ltd.
5. Hydraulic Machines: D.S. Kumar.

Recommended Prerequisite: Fluid Mechanics (CE201) **Co-requisite:** None

REFRIGERATION AND AIR CONDITIONING
ME315
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT –I

Refrigeration :

Introduction to refrigeration system, Methods of refrigeration, Carnot refrigeration cycle, Unit of refrigeration, Refrigeration effect and C.O.P.

Air Refrigeration Cycle :

Open and closed air refrigeration cycles, Reversed carnot cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Classification of aircraft refrigeration system. Simple air refrigeration system. Boot strap refrigeration, Regenerative, Reduced ambient, Dry air rated temperature (DART) **8**

UNIT-II

Vapour Compression System :

Single stage system, analysis of vapour compression cycle, use of T-S and P-H charts, Effect of change in suction and discharge pressures on C.O.P., Effect of sub cooling of condensate and superheating of refrigerant vapour on C.O.P. of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas, Intercooling, Different configuration of Multistage system, Cascade system. **8**

UNIT-III

Vapour Absorption System:

Working Principle of vapour absorption refrigeration system, Comparison between absorption and compression system, Elementary idea of refrigerant absorbent mixtures, Temperature-concentration diagram and Enthalpy-concentration diagram, Adiabatic mixing of two streams, Ammonia- Water vapour absorption system, Lithium-Bromide water vapour absorption system, Comparison. **5**

Refrigerants:

Classification, Nomenclature, Desirable properties of refrigerants, Common refrigerants, Secondary refrigerants and CFC free refrigerants. **3**

UNIT-IV

Air Conditioning :

Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body Effective temperature and comfort chart, Cooling and heating load calculations, Selection of inside and outside design conditions, Heat transfer through walls & roofs, Infiltration and ventilation, Internal heat again, Sensible heat factor (SHF), By-pass factor, Grand Sensible heat factor (GSHF), Apparatus dew point (ADP). **9**

UNIT-V

Refrigeration Equipment and Application:

Elementary knowledge of refrigeration and air conditioning equipments e.g. compressors, condensers, evaporators and expansion devices, Air washers, Cooling towers and humidifying efficiency, Food preservation, cold storage, Refrigerates Freezers, Ice plant, Water coolers, Elementary knowledge of transmission and distribution of air through ducts and fans, basic difference between comfort and industrial air conditioning. **7**

Books:

1. Refrigeration and Air conditioning : Manohar Prasad, New Age
2. Refrigeration and Air conditioning: C.P. Arora, TMH
3. Refrigeration and Air conditioning: Arora and Domkundwar, Dhanpat Rai
4. Refrigeration and Air conditioning: Stoecker and Jones
5. Refrigeration and Air conditioning: Roy J. Dossta
6. Refrigeration and Air conditioning: P.L. Baloney
7. Thermal Environment Engg. : Kuhen, Ramsey and Thelked

Recommended Prerequisite: Applied Thermodynamics (ME202), Heat and Mass Transfer (ME304) **Co-requisite:** None

TRIBOLOGY
ME316
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT-I

Introduction to Tribology
Definition, Scope, Applications, Friction, Definition, Scope, Laws of friction. Friction theories. Surface contaminants, Effect of sliding speed on friction. **6**

UNIT-II

Wear
Definition, Scope, wear of metals, Types, Classification. Mechanism of wear, Quantitative laws. Hypothesis of Holm. Hypothesis of Burwell and Strang. Hypothesis of Archard, Rawe, Rabinowicz. Quantitative law for Abrasive wear, Bayerku surface fatigue theory. Delamination theory & Fatigue theory of wear, wear resistant materials. Introduction to wear of Polymers and Ceramics. Wear reduction by Surface Improvements, Pitting, Erosion & Stress Corrosion. **10**

UNIT-III

Surface Interactions
Elastic & Plastic deformation of surfaces. Contact of Solids, Contact of Ideally Smooth Surfaces. Distribution of Pressure over elastic contact of two curvilinear bodies. Formulae for calculation of contact area. Physico-Mechanical properties of surface layers, Characteristics of Surface Geometry. Classes of surface roughness. Contact of rough surfaces. Interaction of surface peaks. Real and contour area of contact. **10**

UNIT-IV

Lubrication
Definition & Scope. Generalized Reynold's equation. Flow and shear stress, energy equation. Mechanism of pressure development in bearings. Concept of Boundry Layer. **6**

UNIT-V

Bearing design considerations & characteristics
Bearing design procedure & steps. Plain slider bearing. Step (Rayleigh step) bearing. Infinitely long journal bearing. Infinitely short journal bearing. Future scope and applications. **8**

REFERENCE BOOKS:

1. Introduction to Tribology of bearings by - B. C. Majumdar., S Chand & Co.
2. Hand Book of Tribology -- WHILEY
3. Fundamentals of Fluid film lubrication by – Bernard Hamrock, Mc Graw Hill International Edition.
4. Tribology in Industries by Sushil. K. Srivastava, S Chand & Publications.
5. Basic Lubrication theory by Alastair Cameron.

Recommended Prerequisite: Materials Science (ME201) **Co-requisite:** None

SIX SIGMA METHODS, APPROACH AND APPLICATION
ME317
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT –I

Quality perception: Introduction to Quality Concept, Quality in manufacturing, Quality in service sector, statistical foundation and methods of quality improvement.

Descriptive statistics: data type mean, median, mode, range, deviation, skewness and kurtosis.

Difference between conventional and six sigma concepts of Quality. **8**

UNIT-II

Basic of six sigma: concepts of six sigma, defects DPMO, DPU, Z score, attacks on X's, understanding six sigma organization, leadership council, project sponsors and champions, master black belt, black belt and green belts, customer focus, six sigma for manufacturing, six sigma for service, six sigma success stories **8**

UNIT-III

Methodology of six sigma: DMAIC, DFSS, Six sigma tool: project charter, process mapping, measurement system analysis, hypothesis testing, quality function deployment, failure mode and effect analysis, design of experiments **8**

UNIT-IV

Role of control charts, Variable control charts, Attribute control charts, Interpretation of control charts, Process Capability Index, Estimating Capability and Performance Indices, Point Estimate for Capability and Performance Indices, Confidence interval for Capability and Performance Indices, Connection with Tolerance intervals

8

UNIT-V

Steps in implementation of six sigma, selection of six sigma projects, sustenance of six sigma communication plan, company culture, reinforcement and control. **8**

Books:

1. Six Sigma, SPC and TQM in manufacturing and service: Geoff Tennant Gower
2. Six Sigma for managers: Greg Brue, TMH
3. What is Six Sigma: Peter S Pande, TMH
4. The Six Sigma way: Peter S Pande, TMH
5. Introduction to Six Sigma- Methods, Approach and Application – N A Siddiqui & Abhishek Dwivedi

Recommended Prerequisite: None **Co-requisite:** None

POWER PLANT ENGINEERING
ME318
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT –I

Introduction :

Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion, steam generators steam prime movers, steam condensers, water turbines. **3**

Energy audit concepts, Energy audit based on 1st law and 2nd law of thermodynamics, Mass & energy balances, Availability Analysis, Evaluation of Energy conserving opportunities, Economic Analysis & life cycle costing **3**

Variable Load Problem:

Industrial production and power generation compared, ideal and realized load curves, terms and factors. Effect of variable load on power plant operation, methods of meeting the variable load problem. **2**

Power Plant Economics and Selection :

Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit, depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection. **3**

UNIT-II

Steam Power Plant :

Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories. General layout of steam power plant. Different systems such as fuel handling system, pulverizers and coal burners, combustion system, draft, ash handling system, feed water treatment and condensers and cooling system, turbine, auxiliary systems such as governing, feed water heating, reheating, flange heating and gland leakage. Trouble shooting and remedies. **8**

UNIT-III

Diesel Power Plant :

General layout. Performance of diesel engine, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, cooling system, diesel plant operation and efficiency, heat balance, trouble shooting and remedies. **2**

Gas Turbine Power Plant :

Elements of gas turbine power plants, regeneration and reheating cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, performance and trouble shooting and their remedies. Combined cycle power plants. **6**

UNIT-IV

Nuclear Power Plant :

Principal of nuclear energy, basic components of nuclear reactos, nuclear power station, trouble shooting and remedies.

Hydro Electric Station :

Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run-off size of plant and choice of UNIT, operation and maintenance, hydro systems, interconnected systems, trouble shooting and remedies. **3**

Introduction to non conventional power plants (Solar, wind, geothermal, tidal) **4**

UNIT-V

Electrical System :

Generators and generator cooling, transformers and their cooling, bus bar, etc. **2**

Instrumentation :

Purpose, classification, selection and application, recorders and their use,

Listing of various control rooms. **2**

Pollution due to power generation **2**

Books:

1. Power Plant Engineering : F.T. Morse, Affiliated East West press Pvt. Ltd.
2. Power Plant Engineering : Verma Mahesh, Metropolitan Book Co.
3. Modern Power Station Practice : Central Electicity Generating Board (UK)
4. Power Plant Technology : El-Vakil, McGraw Hill.

Recommended Prerequisite: Basic Mechanical Engg.(ME – 101)
Applied Thermodynamics (ME202)

Co-requisite: **None**

FINITE ELEMENT METHOD
ME319
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT I **8**

Introduction

Introduction to finite difference method and finite elements method, Historical Backgrounds, Advantages and limitations, Mathematical formulation of FEM, Different approaches in Finite Element Method - Direct Stiffness approach, simple examples, Variational approach, Rayliegh Ritz method, Weighted Residual methods, Point Collocation method, Galarkin method - Steps involved in FEM.

Basic equations of elasticity, stress,strain. Displacement relations. Finite element formulation of boundary value problems. Various methods used in FEM analysis, Steps used in FEM Analysis.

UNIT II **8**

ONE DIMENSIONAL FINITE ELEMENT ANALYSIS

FE Modeling, general form of total potential for 1-D applications – generic form of finite element equations – linear bar element – quadratic element –nodal approximation – development of shape functions – element matrices and vectors – example problems – extension to plane truss– development of element equations – assembly – element connectivity – global equations – solution methods

ANALYSIS OF BEAMS: Shape functions-element stiffness matrix for two nodes, two degrees of freedom pernode beam element, load vector, deflection, stresses.

UNIT III **8**

TWO DIMENSIONAL FINITE ELEMENT ANALYSIS

Introduction – approximation of geometry and field variable – 3 node triangular Elements – four nodded rectangular elements – higher order elements – generalized coordinates approach to nodal approximations – difficulties – natural coordinates and coordinate transformations – triangular and quadrilateral elements – is-parametric elements – structural mechanics applications in 2-dimensions – elasticity equations – stress strain relations – plane problems of elasticity – element equations – assembly – need for quadrature formula – transformations to natural coordinates – Gaussian quadrature – example problems in plane stress, plane strain and ax symmetric applications

UNIT IV **8**

DYNAMIC ANALYSIS USING FINITE ELEMENT METHOD

Introduction – vibration problems – equations of motion based on weak form – longitudinal vibration of bars – transverse vibration of beams – consistent mass matrices – element equations –solution of eigen value problems – vector iteration methods – normal modes – transient vibrations – modeling of damping – mode superposition technique – direct integration methods

UNIT V **8**

APPLICATIONS IN HEAT TRANSFER & FLUID MECHANICS

One dimensional heat transfer element – application to one-dimensional heat transfer problems- scalar variable problems in 2-Dimensions – Applications to heat transfer in 2- Dimension – Application to problems in fluid mechanics in 2-D, Software based Analysis.

TEXT BOOK:

1. P.Seshu, “Text Book of Finite Element Analysis”, Prentice-Hall of India Pvt. Ltd. New Delhi, 2007. ISBN-978-203-2315-5

REFERENCE BOOKS:

1. J.N.Reddy, “An Introduction to the Finite Element Method”, McGraw-Hill International Editions (Engineering Mechanics Series), 1993. ISBN-0-07-051355-4

2. Chandrupatla & Belagundu, “Introduction to Finite Elements in Engineering”, 3rd Edition, Prentice-Hall of India, Eastern Economy Editions. ISBN-978-81-203-2106-9

3. David V.Hutton,”Fundamentals of Finite Element Analysis”, Tata McGraw-Hill Edition 2005. ISBN-0-07-239536-2

4. Cook,Robert.D., Plesha,Michael.E & Witt,Robert.J. “Concepts and Applications of Finite Element Analysis”,Wiley Student Edition, 2004. ISBN-10 81-265-1336-5

Recommended Prerequisite: Engineering Mathematics – III (MT – 201) **Co-requisite:** **None**

ADVANCED MACHINE DESIGN
ME320
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT –I
Spur Gears: Conjugate action, Involute Gears, gear cutting methods, Tooth loads, Strength of spur gears in bending and in wear.
Dynamic loading, Gear materials, design of gears and involute splines. Gear profile corrections, AGMA and Indian standards. **6**

UNIT-II
Helical Gears: Tooth relationship, tooth proportions. Design of helical gears, crossed helical gears, AGMA and Indian standards. **6**

Worm and Bevel Gears: Analysis of loads and stresses, power rating, Efficiency, Gear standards and proportions. **6**

UNIT-III
Bearing and Lubrication: Types of ball bearings, Roller bearing, Needle roller bearing, Life of bearing, Reliability considerations, Selection of ball, roller tapered roller and thrust bearings, Lubrication and sealing. Mounting of bearings. **6**

UNIT-IV
Sliding Bearings: Hydrodynamic theory of lubrication, Types of bearings, Design of bearings using design charts, Boundary lubrication, hydrostatic bearings, hydrodynamic thrust bearings. Lubrication and lubricants. **8**

UNIT-V
Engine Parts: Design of engine parts such as connecting rod, crankshaft and cylinder and piston. **8**

Books:

1. Mechanical Engineering Design: Joseph E. Shigley McGraw Hill Publications.
2. Design of Machine Members: Alex Valance and VI doughtie, McGraw Hill
3. Machine Design: D.N. Reshetov, Mir Publishers: Moscow.
4. Machine Design: M.F. Spott. Prentice Hall India
5. Fundamental of Machine Design: (vol: 1, 1-5) Popov, Mir Pub. Moscow
6. Machine Elements: Dobrovsky, Mir, Pub. Moscow Data Books
7. Fundamentals of Machine Design: Richard M. Phelan, TMh
8. Machine Design: Maleev and Hartman, CBS
9. Machine Design: Sharma and Agrawal, Kataria
10. Design of Machine Elements: Bhandari, TMH
11. Machine Design: Black and Adams, McGraw Hill.

Recommended Prerequisite: Strength of Materials (ME203)
Machine Design (ME301)

Co-requisite: **None**

INDUSTRIAL ERGONOMICS
ME321
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

Unit-I

Introduction: Importance applications and principles of occupational ergonomics. **2**

Physiological Principles: Muscular work, Nervous control of movements, Improving working efficiency. Optimal use of muscle strength. /Guidelines for work layout. **4**

Skilled work: Acquiring skill, control of skilled movements. Design of tools and equipments for skilled work. 3

Unit-II

Heavy work: Energy consumption, Efficiency, Heart rate as a measure of workload. **2**

Work-station Design: Anthropometric data, Reach and clearance dimensions. Percentiles to be accommodated. **5**

Unit-III

Working Heights: Comfortable working postures. Room to grasp or move things, and operate controls. Sedentary work. Its advantages, disadvantages and limitation. Sedentary workplace design. Design of VDT workstations, Design of Key board. **5**

Handling Lads: The Human spine, back troubles associated with industrial work, Intervertebral disc, disc pressure, slip of disc, Bio-mechanical models of lower back. Recommendations for handling loads. **3**

Man-Machine System: Display equipment, Controls, Relation between control and display instruments, Mental activity, Fatigue, Occupational stress, Job design in monotonous task. **3**

Unit-IV

Human Visual System: Accommodation, Aperture of the pupil, Adaptation of reline, eye movements Visual capacity, Visual strain, Physiology of reading. **3**

Ergonomic Principles of Lighting: Light sources, measurement, physiological requirements of artificial lighting, arrangement of light. Light for fine work and for VDT offices. **3**

Unit-V

Noise and Violation: Sound perception, Noise load, damage to hearing, physiological and psychological effects of noise. Protection against noise, Vibrations and their effect on performance. **3**

Working Environment: Thermo-regulation in human body, comfort indoors, Air quality and its dryness, Air pollution and ventilation. Heat in industry Recommendations for comfort indoors. Daylight, colours and music for pleasant work environment. **4**

Books:

1. Fitting the task to the Man, E. Gandjean, Taylor and Francis.
2. A guide to Ergonomics of Manufacturing, Helander, M., East-West Press.
3. Human Factor in Engineering and Design, Sanders, M.S., and Mc Cormik, E.J., McGraw.Hill

Recommended Prerequisite: None **Co-requisite:** None

APPLIED ELASTICITY
ME322
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT-I

Analysis of Stress: Concept of Stress, Stress Components, Equilibrium Equations, Stress on a General Plane (Direction Cosines, Axis Transformation, Stress on Oblique Plane through a point, Stress Transformation), Principal Stresses, Stress Invariants, Deviatoric Stresses, Octahedral Stresses,
Plane Stress, Stress Boundary Condition Problem. 8

UNIT-II

Analysis of Strain: Deformations (Lagrangian Description, Eulerian Description), Concept of Strain, Strain Components (Geometrical Interpretation), Compatibility Equations, Strain transformation, Principal Strains, Strain Invariants, Deviatoric Strains, Octahedral Strains, Plane Strain, Strain Rates. 8

UNIT-III

Stress-Strain Relations: One-Dimensional Stress-Strain Relations (Idealized Time independent and Time –dependent stress-strain laws), Linear Elasticity (Generalized Hooke's Law), Stress-Strain Relationships for Isotropic and Anisotropic Materials (Plane stress and Plane Strain). 8

UNIT-IV

Basic Equations of Elasticity for Solids: Stresses in Terms of displacements, Equilibrium Equations in terms of displacements, Compatibility equations in Terms of Stresses, Special cases of Elasticity equations (Plane Stress, Plane strain, Polar Co-ordinates), Airy's Stress Function (Plane stress, Plane strain, Polar Co-ordinates). 8

UNIT-V

Torsion: Introduction, Circular shaft, Torsion of non-circular cross-section, St. Venant's theory, Warping function, Prandtl's stress function, Shafts of other cross-sections, Torsion of bars with thin walled sections. 8

References:

1. "Mathematical Theory of Elasticity" by I. S. Sokolnikoff.
2. "Advanced Mechanics of Materials" by Boresi.
3. "Theoretical Elasticity" by A. E. Green and W. Zerna.
4. "Theory of Elasticity" by Timoshienko.
5. "Advanced Strength and Applied Elasticity" by A. C. Ugural and S. K. Fenster.
6. "Applied Elasticity" by R.T.Fenner.
7. "Advanced Strength of Materials" by L. S. Srinath.

Recommended Prerequisite: Strength of Materials (ME203)
Machine Design (ME301)

Co-requisite: **None**

ADVANCED FLUID MECHANICS
ME323
w.e.f. Session 2017-18

L	T	P	C
3	1	0	4

UNIT-I
Review of kinematics of fluid motion, method of describing fluid motion, translation, rate of deformation, the material derivatives, acceleration, vorticity in cartesian & polar coordinates, Reynolds transport theorem, Stress at a point, velocity profile, wall shear stress. **7**

UNIT-II
Non-viscous incompressible flow- Equation of continuity, Euler's equation of motion, Bernoulli's equation, circulation and its theorem, stress function, velocity potential, irrotational flow, two dimensional source, sink, source-sink pair, doublet vortex, superposition of source-sink with rectilinear flow, Rankine body, Superposition of rectilinear flow and doublet, flow around a spinning circular cylinder, Magnus effect, lift & Drag, Skin friction. Lift of aerofoils. **9**

UNIT-III
Boundary layer Concept-Introduction to boundary layer formation, Novier-stokes equation, Boundary layer thickness, momentum thickness, energy thickness, Boundary layer equations, Momentum-Integral equation - Von Korman, Blasius solution of boundary layer on a flat plate without pressure gradient, Flow with very small Reynolds number, Hogen poisseuille flow, Plane Couette flow, Hydrodynamic theory of lubrication. **8**

UNIT-IV
Compressible flow- Propagation of pressure change, sound velocity, elastic waves, Mach number, Mach cone, isentropic flow relations in terms of sonic velocity and mach number, Stagnation properties, Regions of flow, Energy equation, Effect of Mach number on compressibility. Propagation of infinitesimal waves, Non-steep finite pressure wave and steep finite pressure waves, Expansion waves Isentropic flow with variable area, Mach number variation and its effect on Flow through nozzles and diffusers. Area ratio, impulse function, Use of Gas/Air tables. **8**

UNIT-V
Flow with normal shock waves- Development of shock wave, rarefaction wave, governing equations, Prandtle-Meyer relation. Thermodynamic properties across shock. Wind tunnels. **3**
Flow in constant area duct with friction-Fanno curves, Fanno flow equations, Solution of fanno flow equations. Variation of flow properties. Tables & charts for Fanno flow. **3**
Flow in constant area duct with heat transfer- Rayleigh line, Fundamental equations, Rayleigh flow relation, Variation of flow properties. Tables & Charts for Rayleigh flow. **2**

Books/ References:

1. Fluid Mechanics by White.
2. Fluid Mechanics by Streeter
3. Fluid Mechanics by Som & Biswas
4. Fluid Mechanics by K.L. Kumar
5. Fluid Mechanics by A.K. Jain
6. Fluid Mechanics by Robert W. Fox & Alan T. Mc Donald, Wiley Students Edition
7. Fundamentals of Compressible flow by S.M. Yahya
8. Gas Dynamics by Z. Hussain
9. Viscous fluid flow by White
10. Computational Fluid Dynamics by Anderson
11. Gas Dynamics by E. Radhakrishnan
12. Fluid Mechanics by Kundu & Cohen, Academic Press, Elsevier

Recommended Prerequisite: Fluid Mechanics (CE201)
Engg. Mathematics - I (MT – 101)
Engg. Mathematics II (MT-112)

Co-requisite: None

FLUID MACHINERY LAB

ME324

(Say minimum 8 experiments out of following)

w.e.f. Session 2017-18

L	T	P	C
0	0	2	1

1. Experiment on Impact of jet.
2. Experiment on Pelton wheel Turbine.
3. Experiment on Francis turbine.
4. Experiment on Kaplan turbine.
5. Experiment on Reciprocating pump.
6. Experiment on Centrifugal pump
7. Experiment on Gear oil pump.
8. Experiment on Hydraulic Brake/Jack.
9. Experiment on Hydraulic Ram
10. Study through first visit of any pumping station/plant.
11. Study through second visit of any pumping station/plant.
12. Any other suitable experiment / text rig such as comparison and performance of different types of pumps and turbines.

REFRIGRATION AND AIR CONDITIONING LAB

ME325

(Say minimum 8 experiments out of following)

w.e.f. Session 2017-18

L	T	P	C
0	0	2	1

1. Experiment on the refrigeration test-rig and calculation of various performance parameters.
2. To study different types of expansion devices used in a refrigeration system.
3. To study different types of evaporators used in refrigeration systems.
4. To study basic components of an air-conditioning system.
5. Experiment on air-conditioning test-rig and calculation of various performance parameters.
6. To study air washers.
7. Study of a window air conditioner
8. Study and determination of volumetric efficiency of a compressor.
9. Visit of a central air conditioning plant.
10. Visit of a cold storage plant.