Third Year B.Tech Structure with effect from Academic Year 2017-18

MECHANICAL ENGINEERING

SEMESTER V

Sl. No.	Code	Subject	Type	Teaching Scheme			Assessment Scheme						Credits
				L	P	T	ISA					ESA	
							Test	HA	T	Mid-Sem	CA	ESE	
S1	ME30108	Internal Combustion Engines	Theory – Core	3	-	-	15	5	-	20	-	60	3
S2	ME30109	Design of Machine Elements	Theory – Core	3	-	-	15	5	-	20	-	60	3
S3	ME31110	Fluid Machinery & Fluid Power Engineering	Theory – Core / MD	3	-	1	10	5	5	20	-	60	4
S4	ME30111	Dynamics of Machines	Theory – Core	3	-	1	10	5	5	20	-	60	4
S5	ME31112	Production Metallurgy	Theory – MD	3	-	-	15	5	-	20	-	60	2
P1	ME30308	IC Engines Lab	Lab – Core	-	2	-	-	-	-	-	70	30	1
P2	ME30309	Mechanical Design Lab - I	Lab – Core	-	2	-	-	-	-	-	70	30	1
P3	ME31310	Fluid Machinery & Fluid Power Lab	Lab – MD	-	2	-	-	-	-	-	70	30	1
P4	CS31361	Object Oriented Programming Lab	Lab – PD	-	2	-	-	-	-	-	70	30	1
MP	ME37397	Mini Project	Project	-	4	-	-	-	-	-	70	30	2
	ME37401	Comprehensive Viva Voce*	Oral	-	-	-	-	-	-	-	-	100	2
P5	ME30310	Technical Seminar	Lab	-	2	-	-	-	-	-	70	30	1
			Total:	15	14	2							25

* Based on any two core theory subjects as recommended by the BoS. (**Internal Combustion Engines, Design of Machine Elements**)

L: Lecture, **P**: Practical, **T**: Tutorial, **ISA**: In-semester Assessment, **ESA**: End-semester Assessment, **HA**: Home Assignment, **CA**: Continuous Assessment (for practical), **ESE**: End-semester Examination, **MD**: Multi-disciplinary, **PD**: Professional Development

REF NO: To be filled by CD office

ME30109:: Design of Machine Elements

Credits: 03 **Teaching Scheme: -** Theory 03 Hrs/Week

Prerequisites:
The Students should have knowledge of

1. Engineering Mechanics
2. Mechanics of Solids
3. Basic Manufacturing Processes
4. Kinematics of Machines

Course Objectives:

The main objective of the course is to build a strong foundation and to acquaint the students with the

1. fundamentals and the phases of machine design.
2. understanding on the process of material selection and design.
3. use of design data books & various codes of practice.
4. concepts of strength design related to various machine elements.
5. design methodology for simple joints, couplings, fasteners, levers and springs under static loading.

Course Details:

Unit 1: Fundamentals of Machine Design (04 Hrs)

U1.1 Static Loads, Types of stresses, Different Criteria for Design, Design Process, Design considerations, Factors influencing machine design, Standardization and Interchangeability of machine elements, Use of Preferred numbers, Fits and Tolerances, Indian standard and codes for Ferrous and Non-ferrous materials, Allowable stress, Factor of safety, Service factor, Use of Code/Data books.

U1.2 Maximum Principal Stress and maximum shear stress for combined axial, bending and shear loading, Use of Preferred series.

Unit 2: Design of Temporary and Permanent Joints (10 Hrs)

U2.1 Temporary Joints: Socket and spigot cotter joint, Knuckle joint
Permanent Joints: Riveted joints: Types, Modes of failure, boiler joint, Welded joints: Types, Design for various loading conditions.

U2.2 Sleeve and Cotter, Cotter with a Gib, Structural riveted joint, Basic weld symbols.

Unit 3: Design of Shaft, Keys and Couplings (14 hrs)

U3.1 Shafts: Maximum Principal Stress and maximum shear stress for combined axial, bending and torsional loading in shafts, Materials, Types, Standard sizes.
Keys: Types, Design of Rectangular Sunk key.
Couplings: Types, Design of Rigid Flange Coupling and Flexible Bushed Pin Coupling.

U3.2, Design of Feather key, Woodruff key, Tangent key, Taper pin, Splines, Muff Coupling, Clamp or Compression Coupling.

Unit 4: Power Screws and Threaded joints (06 hrs)

U4.1 Forms of threads, Designation of screws, Multiple start screws, Self locking screw, Torque analysis and design of power screws with square and trapezoidal threads, Design of Screw jack, Bolts of uniform strength.

U4.2 Basic types of screw fasteners, Design of Eye-bolt, Wall bracket.

Unit 5: Mechanical Springs and levers (06 hrs)

U5.1 Springs: Stress and deflection equations for helical compression Springs, Types of ends, Design of helical compression and tension springs, Helical torsion Spring, Surge in springs, Design of semi-elliptical leaf springs.
Levers: Design of lever for safety valve, bell crank lever.

U5.2 Types, applications and materials for springs, Classification of levers, Design of hand lever, foot lever, cranked lever.

Course Outcomes:

The students will be able to

CO1: Explain basic principles in the design of machine elements & apply them effectively from material selection to design analysis using design data book to interpret standardized data.
CO2: Design and analyze permanent and temporary joints under various loading conditions.
CO3: Design and analyze power transmission shafts and couplings with different geometrical features under various loading conditions.
CO4: Explain various thread forms and design power screws.
CO5: Identify types of springs & levers and perform design analysis.

DESIGN DATA HAND BOOKS:

1. "Design Hand Book", S.M. Jalaluddin; Anuradha Agencies Publications
2. "P.S.G. Design Data Hand Book", PSG College of Tech Coimbatore
3. "Machine Design Data Book", K. Lingaiah, Tata McGraw Hill

TEXT BOOKS:

T1. "Mechanical Engineerng Design", J.E. Shigley, C.R. Mischke, R.G. Budynas and K.J. Nisbett, Tata McGraw-Hill , 8th Edition, 2008

T2. "Design of Machine Elements", V.B. Bhandari, Tata McGraw-Hill, 3rd Edition, 2010.

T3. "A Text Book of Machine Design", R.S. Khurmi and J.K. Gupta, S.Chand Publication, 14th Edition, 2005.

REFERENCE BOOKS:

R1. "Design of Machine Elements", M.F. Spotts, T.E. Shoup and L.E. Hornberger, Pearson/Prentice Hall, 8th Edition, 2007.

R2. "Machine Design", P.C. Sharma and D.K. Agrawal, S.K.Kataria & Sons, 11th Edition, 2007.

R3. "Machine Design", R.L. Norton, Pearson Education Asia, 5th Edition, 2001.

R4. "Fundamental of Machine Component Design", R.C. Juvinall and K.M. Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007

R5. "Machine Design", P. Kanaiah, Scietech Publications, 2nd Edition, 2008

OPEN SOURCES:

- http://nptel.ac.in
- http:// ocw.mit.edu/courses/mechanical-engineering/
- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

ME30111:: Dynamics of Machines

Credits: 03 **Teaching Scheme: -** Theory 03 Hrs/Week

Prerequisites:

1. Engineering Mechanics
2. Engineering Graphics Lab
3. Kinematics of Machines

Course Objectives:

The main objective of the course is to build a strong foundation and to acquaint the students with the

1. techniques of force analysis for different components used in machines.
2. analysis of flywheel for engines as well as for different machines.
3. understanding of static and dynamic balancing of high speed rotors as well as multi-cylinder engines used in practice.
4. concepts of speed control systems for engines and gyro-stabilizers for ships and aeroplanes
5. analysis of journal bearings, friction clutches and other friction driven devices.

Course Details:

Unit 1: Dynamic Force Analysis (08 Hrs)

U1.1. D'Alembert's Principle, Inertia force and torque, Dynamic force analysis of reciprocating engines, Piston effort, Crank effort, turning moment on crank shaft (without and with inertia of connecting rod), Turning moment diagram of single and multi-cylinder engines, Fluctuation of energy and speed, Dynamic analysis of flywheel.

U1.2. Flywheels for different types of engines and machines as used in practice, dynamic force analysis of four bar mechanism

Unit 2: Balancing of Rotating Masses (06 Hrs)

U2.1. Introduction to balancing, Static and dynamic balancing, Internal and External balancing, Balancing of single and multiple revolving masses in same plane, Balancing of several revolving masses in different planes.

U2.2. Static and dynamic balancing machines, Field balancing of discs and rotors, Balancing techniques as used in industries.

Unit 3: Balancing of Reciprocating Masses: (06 Hrs)

U3.1. Introduction to types of reciprocating engines, Partial balancing of single cylinder engines, Primary and Secondary balancing of multi-cylinder inline and radial engine, Concept of firing order, Analytical method for V engines.

U3.2. Balancing of multi-cylinder inline cum V & W engines using direct and reverse crank methods as used in practice, Crank orientation for multi-cylinder inline engines with proper firing order.

Unit 4: Mechanism for Speed and Stability Control: (10 Hrs)

U4.1. Governor for speed control, Gravity and spring controlled governors, Governor Characteristics, Controlling force curves, stability, isochronisms, hunting, Effect of friction on equilibrium speed and range of speed, coefficient of insensitiveness, Gyroscopic couple, Gyroscopic effect on stability of aeroplanes, ships, four-wheeler and two-wheeler.

U4.2. Governor effort and power, Use of Governor in steam and I.C. engines, Use of gyrostabilizers in practice.

Unit 5: Friction in Different Industrial Applications: (10 Hrs)

U5.1. Screw threads and screw jacks, pivot, collar and radial journal bearings, friction clutches, working principle of brakes and dynamometers with simple examples.

U5.2. Different bearings, brakes and dynamometers as used in industries.

Course Outcomes:

Students will be able to

CO1: understand the technique of force analysis for different components used in machines.

CO2: carry out dynamic analysis of flywheel for engines as well as for different machines.

CO3: perform static and dynamic balancing of high speed rotors and multi-cylinder engines used in practice.

CO4: develop concepts of speed control systems for engines, and gyro-stabilizers for ships and aeroplanes.

CO5: carry out dynamic analysis of friction clutches, journal bearings as well as other friction driven devices.

TEXT BOOKS:

T1. "Theory of Machines", Thomas Bevan, CBS Publishers and Distributors, 3rd Edition, 2005.

T2. "Theory of Machines", S.S Rattan., Tata McGraw-Hill, 3rd Edition, 2009.

REFERENCES:

R1. "Kinematics and Dynamics of Machinery", Robert L. Norton, Tata McGraw-Hill, 1st Edition, 2009.

R2. "Theory of Mechanisms and Machines", A. Ghosh and A.K., Mallick, East-West Pvt. Ltd., 3rd Edition, 2001

R3. "Mechanisms and Machine Theory", J.S. Rao and R. V. Dukkipati, Wiley-Eastern Ltd., 2nd Edition, 2008.

R4. "Theory of Machines and Mechanisms", J.J. Uicker, G .R. Pennock and J. E. Shigley, Oxford University Press, 3rd Edition, 2009.

Open sources:

- http://nptel.ac.in
- http:// ocw.mit.edu/courses/mechanical-engineering/
- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

ME30111:: Dynamics of Machines

Credits: 01 **Teaching Scheme: -** Tutorial 01 Hr/Week

Prerequisites:

1. Engineering Mechanics
2. Engineering Graphics Lab
3. Kinematics of Machines

Course Objectives:

The main objective of the course is to build a strong foundation and to acquaint the students with the

1. techniques of force analysis for different components used in machines.
2. analysis of flywheel for engines as well as for different machines.
3. understanding of static and dynamic balancing of high speed rotors as well as multi-cylinder engines used in practice.
4. concepts of speed control systems for engines and gyro-stabilizers for ships and aeroplanes
5. analysis of journal bearings, friction clutches and other friction driven devices.

Course Details:

List of Contents

Tutorial No. 1: Numericals on dynamic force analysys of different components of reciprocating engine mechanism.

Tutorial No. 2: Numericals on analysis of flywheel.

Tutorial No. 3: Numericals on balancing of rotating masses in single plane

Tutorial No. 4: Numericals on balancing of rotating masses in several planes.

Tutorial No. 5: Numericals on balancing of reciprocating masses.

Tutorial No. 6: Numericals on gravity controllrd governor.

Tutorial No. 7: Numericals on spring controlled governor.

Tutorial No. 8: Numericals on effect of gyroscopic couple on ship, aeroplane.

Tutorial No. 9: Numericals on screw jack.

Tutorial No. 10: Numericals on friction clutches.

Tutorial No. 11: Numericals on brakes and dynamometers.

Course Outcomes:

Students will be able to

CO1: understand the technique of force analysis for different components used in machines.

CO2: carry out dynamic analysis of flywheel for engines as well as for different machines.

CO3: perform static and dynamic balancing of high speed rotors and multi-cylinder engines used in practice.

CO4: develop concepts of speed control systems for engines, and gyro-stabilizers for ships and aeroplanes.

CO5: carry out dynamic analysis of friction clutches, journal bearings as well as other friction driven devices.

TEXT BOOKS:

T1. "Theory of Machines", Thomas Bevan, CBS Publishers and Distributors, 3rd Edition, 2005.

T2. “Theory of Machines”, S.S Rattan., Tata McGraw-Hill, 3rd Edition, 2009.

REFERENCES:

R1. "Kinematics and Dynamics of Machinery", Robert L. Norton, Tata McGraw-Hill, 1st Edition, 2009.

R2. "Theory of Mechanisms and Machines", A. Ghosh and A.K., Mallick, East-West Pvt. Ltd., 3rd Edition, 2001

R3. "Mechanisms and Machine Theory", J.S. Rao.and R.V. Dukkipati., Wiley-Eastern Ltd., 2nd Edition, 2008.

R4. "Theory of Machines and Mechanisms", J.J. Uicker, G.R. Pennock and J.E. Shigley, Oxford University Press, 3rd Edition, 2009.

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- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

ME31110:: Fluid Machinery and Fluid Power Engineering

Credits: 03 **Teaching Scheme: -** Theory 03 Hours/Week

Prerequisites:

1. Fluid Mechanics.

Course Objectives:

The main objective of this course is to build a strong foundation and to acquaint the students with

1. performance analysis of turbines using velocity triangles.
2. study of characteristics of turbines for various applications.
3. performance analysis of centrifugal and reciprocating pumps.
4. identification of different hydraulic components and their functions.
5. understanding of the basics of control valves used in different hydraulics circuits.

Course Details:

Unit 1: Impact of Jets and Impulse Turbines (8 Hrs)

U1.3. Flow through nozzles, Impact of jets. Momentum equation and its applications. Hydraulic turbine: Classification, Impulse and Reaction turbine; Tangential, Radial and axial turbine. Pelton turbine, Work done and efficiencies of Pelton Turbines, Velocity Triangles and their analysis, bucket dimensions, number of buckets in Pelton wheel, Governing, Main and Operating Characteristics

U1.4. Inclined and Moving Jet Problems, Governing Mechanisms, Unit Quantities.

Unit 2: Reaction Turbines (8 Hrs)

U2.3. Francis turbine, Work done and efficiencies, Velocity Triangles and their analysis, Kaplan Turbine, Principle of Governing, Operating Characteristics, Draft tube and casing cavitations.

U2.4. Governing Mechanisms

Unit 3: Centrifugal and Reciprocating Pumps (8 Hrs)

U3.3. **Centrifugal Pump**: Classification, construction, working, various heads, velocity triangles, losses and efficiencies, specific speed, net positive suction head (NPSH), Main and Operating Characteristics, Pump in series and parallel, Cavitation.

Reciprocating Pump: Working principle, discharge, work done and power requirement, slip, indicator diagram.

U3.4. Priming and troubleshooting, Unit quantities.

Unit 4: Source of Fluid Power (8 Hrs)

U4.3. A Fluid power system, advantage, application.

Hydraulic Pumps: Elements of Oil Hydraulic System, Hydrodynamic and Hydrostatic Pumps. Gear Pumps, Vane pumps and piston pumps, types, principle and application, Pump performance.

U4.4. Various types of Hydraulic fluids, properties of fluid and their comparison.

Unit 5: Fluid Power Control (8 Hrs)

U5.3. Actuators types, Types of cylinders, Simple Circuits, Reservoir Assembly, Filters, Accumulators.

U5.4. Flow dividers and other special purpose valves: Principles and applications.

Course Outcomes: Students will be able to

CO1: analyze performance of turbines using velocity triangles.

CO2: use the characteristics of turbines for various applications.

CO3: analyze the performance of Centrifugal and Reciprocating pumps.

CO4: identify different hydraulic components and their functions.

CO5: explain the basic of Control valves used in different hydraulics circuits.

Text Books:

T4. "Hydraulics, Fluid Mechanics and Machinery", P N Modi and Seth, Standard Book House, 20th Edition, 2013.

T5. "Fluid Power with application", A Esposito, Prentice Hall, 7th Edition, 2014.

Reference Books:

R6. "Hydraulic Machines", R.K.Rajput, S.Chand Publications, 5th Edition, 1999.

R7. "Theory of Hydraulic Machinery", V. P.Vasandani, Khanna Publishers, Paper Back Edition, 2010.

R8. Vickers Manual on Industrial Hydraulics, 5th Edition, 2008.

R9. "Hydraulic Machines", J Lal, Metropolitan Book Co., Paper Back Edition, 1994.

R10. "Oil Hydraulics-Principle and Maintenance", Majumdar, Tata McGraw Hill, 1st Edition, 2001.

R11. "Industrial Hydraulics", J. H. Pipenger, McGraw Hill, 3rd Revised Edition, 1979.

OPEN SOURCES:

- http://nptel.ac.in
- http:// ocw.mit.edu/courses/mechanical-engineering/
- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

ME31110:: Fluid Machinery and Fluid Power Engineering

Credits: 01 **Teaching Scheme:** Tutorial 01 Hrs/Week

Prerequisites:

1. Fluid Mechanics

Course Objectives:

The main objective of this course is to build a strong foundation and to acquaint the students with

1. performance analysis of turbines using velocity triangles.
2. study of characteristics of turbines for various applications.
3. performance analysis of centrifugal and reciprocating pumps.
4. identification of different hydraulic components and their functions.
5. understanding of the basics of control valves used in different hydraulics circuits.

Course Details:

List of Contents

Tutorial No. 1: Solving numericals based on the applications of impulse momentum principle.

Tutorial No. 2: Solving numericals of Jet Problems.

Tutorial No. 3: Solving numericals of Pelton turbines.

Tutorial No. 4: Solving numericals of Francis turbine.

Tutorial No.5: Solving numericals on velocity triangles, losses and efficiencies of Centrifugal Pumps.

Tutorial No. 6: Solving numericals on Pump in series and parallel.

Tutorial No. 7: Solving numericals on Reciprocating Pump.

Tutorial No. 8: Solving numericals on Pumps in series and parallel.

Tutorial No.9: Solve numerical based on the fluid power system and its components.

Tutorial No.10: Solving numerical on gear pump.

Tutorial No.11: Solving numerical on vane pump.

Tutorial No.12: Solving numerical on design of hydraulic circuit.

Course Outcomes: Students will be able to

CO1: analyze performance of turbines using velocity triangles.

CO2: use the characteristics of turbines for various applications.

CO3: analyze the performance of Centrifugal and Reciprocating pumps.

CO4: identify different hydraulic components and their functions.

CO5: explain the basic of Control valves used in different hydraulics circuits.

Text Books:

T1. "Hydraulics, Fluid Mechanics and Machinery", P N Modi and Seth, Standard Book House, 20th Edition, 2013.

T2. "Fluid Power with application", A Esposito, Prentice Hall, 7th Edition, 2014.

Reference Books:

R1. "Hydraulic Machines", R. K. Rajput, S.Chand Publications, 5th Edition, 1999.

R2. "Theory of Hydraulic Machinery", V. P. Vasandani, Khanna Publishers, Paper Back Edition, 2010.

R3. Vickers Manual on Industrial Hydraulics, 5th Edition, 2008.

R4. "Hydraulic Machines", J Lal, Metropolitan Book Co., Paper Back Edition, 1994.

R5. "Oil Hydraulics-Principle and Maintenance", Majumdar, Tata McGraw Hill, 1st Edition, 2001.

R6. "Industrial Hydraulics", J. H. Pipenger, McGraw Hill, 3rd Revised Edition, 1979.

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- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

ME30108:: Internal Combustion Engines

Credits: 03 **Teaching Scheme: -** Theory 03 Hrs/Week

Prerequisites:

2. Basic Thermodynamics.
3. Fluid Mechanics.
4. Engineering Chemistry.
5. Material Science.

Course Objectives:

The main objective of this course is to build a strong foundation and to acquaint the students with

1. Basic understanding of engine function, performance, design methodology and performance analysis of different IC Engine cycles.
2. Description of different Air and Fuel induction techniques for SI and CI Engines.
3. Explanation of ignition and combustion characteristics for SI and CI Engines.
4. Understanding of supercharging, turbo charging on power output and on performance analysis of internal combustion engines.
5. Understanding of real world engine design issues related to Cooling, Lubrication and engine emission.

Course Details:

Unit 1: Introduction **(10 Hrs)**

U1.5. Classification, Engine nomenclature, engine operating and performance parameters, Valve timing diagram of SI & CI Engines, Comparison of SI and CI engine.

IC Engine Cycles: Air standard cycles, Assumptions, Otto, Diesel, Dual Combustion Cycles, Comparison of Otto, Diesel and Dual cycles, Fuel-air cycles, Effect of variable specific heat, dissociation and operating variables on performance, Actual cycles, Time Loss Factor, Heat Loss Factor, Exhaust Blow down, Loss Due to Gas Exchange Processes, Volumetric Efficiency, Loss due to Rubbing Friction.

U1.2. Numerical on Fuel-Air cycle.

Unit 2: Fuels, Carburetion and Fuel Injection (10 Hrs)

U2.1. Fuels**:** Types of IC Engine fuels, Structure of Petroleum, Petroleum Refining process, Qualities of IC Engine fuels, rating of fuels.

Carburetion: Factors Affecting Carburetion, Mixture requirements, Principle of Carburetion, Simple Carburetor and its drawbacks, Calculation of the Air–Fuel Ratio, Solex Carburetor.

Fuel Injection: Functional Requirements of an Injection System, Classification of Injection Systems, Fuel Feed Pump, Injection Pump, Injection Pump Governor, Mechanical Governor, Pneumatic Governor, Fuel Injector, Nozzle, Injection in SI Engine.

U2.2 Alternative Fuels, Modern developments in Petrol and Diesel Injection System.

Unit 3: Ignition and Combustion in IC Engine (8 Hrs)

U3.5. Ignition: Requirements of an ignition system, conventional ignition systems, firing order, Ignition timing, Spark advance mechanism.

Combustion: Stages of combustion in SI and CI engines, effects of engine variables on flame propagation and ignition delay, abnormal combustion, Pre-ignition & Detonation, Theory of Detonation. Effect of engine variables on Detonation, Control of Detonation. Diesel Knock & methods to control diesel knock, Requirements of combustion chambers. Features of different types of combustion chambers system for S.I. engines and CI. engines.

U3.6. Modern ignition systems (TCI and CDI).

Unit 4: Supercharging, Scavenging, Testing and Performances of IC Engine (6 Hrs)

U4.5. Super Charging & Scavenging: Thermodynamics Cycles of supercharging. Effect of supercharging, Efficiency of supercharged engines. Methods of super charging, supercharging and scavenging of 2-stroke engines.

Testing and Performances: Power, fuel & air measurement methods, Performance characteristic curves of SI & CI engines, variables affecting performance and methods to improve engine performance.

U4.6. Turbo charging: Methods and Limitations.

Unit 5: Cooling, Lubricating Systems, Engine Emission & Controls, Modern Developments (6 Hrs)

U5.1. Cooling & Lubricating Systems: Air cooling & water cooling systems, Effect of cooling on power output & efficiency, Properties of lubricants and different types of lubricating system.

Engine Emission & Controls: Mechanism of pollutant formation and its harmful effects. Methods of measuring pollutants and control of engine emission.

U5.2. Modern developments in IC Engines: EGR, GDI, HCCI, dual fuel engine, Lean burn engine, Stratified engine (basic principles).

Course Outcomes: Students will be able to

CO1: Demonstrate a basic understanding of engine function, performance, design methodology and perform thermodynamic analysis of different IC Engine cycles.

CO2: Describe the Air and Fuel induction techniques for SI and CI Engines.

CO3: Explain ignition and combustion characteristics for SI and CI Engines.

CO4: Understand the effect of supercharging, turbo charging on power output and carry out performance analysis of internal combustion engines.

CO5: Develop an understanding of real world engine design issues related to Cooling, Lubrication and engine emission.

Text Books:

T6. "Internal Combustion Engines", V. Ganesan, TMH, 4th Edition,2012.

T2. "Fundamentals of Internal Combustion Engines", Poul. W. Gill, James H. Smith, Jr. E.J.Zirus, Oxford, 4th Revised Edition, 2007.

T3. "IC Engines" Mathur & Sharma, Dhanpat Rai & Sons, Paper back Edition, 2010.

Reference Books:

R12. "A course in IC Engines", V. M. Domkundwar, Dhanpat rai and sons, Paper back Edition, 2013.

R2. "Fundamentals of Internal Combustion Engines", H.N.Gupta, PHI, 2nd Edition, 2013.

R3. "Internal Combustion Engines", K K Ramalingam, Scitech, 2nd Edition, 2009.

R4. "Fundamentals of IC Engines", J. B. Heywood, McGraw Hill, Paperback Edition, 1989.

R5. "An Introduction To Combustion: Concepts and Applications", Stephen R Turns, TMH, 3rd Edition, 2012.

OPEN SOURCES:

- http://nptel.ac.in
- http:// ocw.mit.edu/courses/mechanical-engineering/
- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

ME31112:: Production Metallurgy

Credits: 02 **Teaching Scheme:** Theory 03 Hrs/Week

Prerequisites:

1. Material Science
2. Material Science Lab

Course Objectives:

The main objective of the course is build to a strong foundation and to acquaint the students with

1. steels for different applications
2. heat treatment for steels
3. surface coating solutions
4. types of alloys and cast iron
5. different types Non ferrous metals and alloys

Course Details:

Unit 1: The Iron-Iron carbide Phase equilibrium Diagram (06 Hrs)

U1.6. Introduction, Iron carbon diagram, Significant Temperatures, Definitions of structures, Carbon solubility in Iron, Slow cooling of steel, Classification of steels

U1.7. Basics of Phase Diagram, Lever Rule, Cooling curve for pure iron.

Unit 2: Heat Treatment of Steels (06 Hrs)

U2.1 Part A: Introduction, Full Annealing, Normalizing, Hardening, Tempering, Isothermal transformation Diagram for eutectic steel, Products of Austenite, Quenching, Hardenability, Austempering

U2.2 Jominy End quench Test

Unit 3: Surface Heat Treatments (04 Hrs)

U3.1 Carburising, heat treatment after carburising, Nitriding, Carbonitriding, Flame hardening and Induction hardening. Commercial heat treatment practice of gears of different sizes, tools, springs.

U3.2 Hardenable Carbon Steels, Isothermal heat treatments

Unit 4: Alloy Steels and Cast iron (06 Hrs)

U4.1 Alloy Steels - Effects of alloying elements, classification of alloying elements. Stainless Steels, Tool steels and tool materials, Special purpose steels with applications. Cast irons- Classification, Gray cast iron, White cast iron, Malleable cast iron, Ductile Iron, Effects of various parameters on structures and properties of cast irons.

U4.2 Applications of cast irons for different components of machine tool, automobiles, pumps etc.

Unit 5: Non ferrous metals and Alloys (08 Hrs)

U5.1 Copper alloys - Brasses, Bronzes-: Tin, Aluminium, Beryllium, Silicon Copper nickel alloys, Nickel - Silver, Aluminium and aluminium alloys. High temperature materials such as Nimonics, Super alloys, Ti-alloys.

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U5.2 Selection of Materials and Failure Prevention: Selection factors, some case studies of common engineering components. Failure prevention through design, proper material selection.

Course Outcomes:

Students will be able to

CO1: select and recommend steels for different applications

CO2: suggest heat treatment process for steels

CO3: suggest different application based surface coating solutions

CO4: familiarize with different types of alloys and cast iron

CO5: familiarize with various types of non ferrous metals and alloys

Text Books:

T1. "Introduction to Physical Metallurgy", Sydney Avner, McGraw Hill Education (India) Private Limited, 2nd Edition, 1974.

T2. "Material Science and Engineering", W F Smith et al, McGraw Hill Education (India) Private Limited, 5th Edition, 2004.

T3. "Material Science and Engineering", V. Raghavan, Prentice Hall of India Private Limited, 5th Edition, 2011.

Reference Books:

R1. "Material science and Engineering an Introduction", W. D. Callister; John Willey and Sons, 8th Edition, 2010.

R2. "Elements of Material Science and Engineering", L. H. Van Vlack , Pearson Education Inc., 6th Edition, 2008.

R3. "Structure and properties engineering materials", V S R Murthy, A K Jena, K P Gupta, G S Murty, Tata McGraw Hill, 2nd Reprint, 2003.

OPEN SOURCES:

- http://nptel.ac.in
- http:// ocw.mit.edu/courses/mechanical-engineering/
- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

CS 31351:: C++ and Object Oriented Programming

Credits: 01 **Teaching Scheme: -** Laboratory 02 Hrs/Week

Prerequisites:

1. Basic C programming concepts.
2. Basic knowledge of various control statements.
3. Basic knowledge of function concepts and the idea of modularity.
4. Basic knowledge of Linux and Window Operating System.

Course Objectives:

- To make the student learn an object oriented way of solving problems.
- To make the student to learn C++ programming language and its support for data abstraction and data hiding.
- Understanding advanced program flow and techniques.
- Understanding pointers, references, pointers to member functions, memory management, constructors and destructors.
- Understanding Inheritance and polymorphism.

Course Details:

1. Basic C++ programs, Input and output statements, C++ Programs to implement various control Structures.
2. Study of Function concept in C++.
3. Study of class and objects in C++.
4. Study of static members.
5. Study of friend function and friend class.
6. Study of various types of inheritance.
7. Study of static polymorphism with function overloading.
8. Study of static polymorphism with operator overloading.
9. Study of dynamic polymorphism with virtual functions.

List of Practical:

Experiment No. 1: Programs to implement basic logic and conditional statements.
- a. General programs
- b. Conditional statements
- c. Switch case

Experiment No. 2: C++ Programs to implement various loop control structures.
- a. While loop
- b. Do-while loop
- c. For loop

Experiment No. 3: Programs to Understand Functions and Recursion
- a. Introduction to function
- b. Types of function
- c. Implementation of Function with default arguments
- d. Recursion

Experiment No. 4: Programs to Understand Different Function Call Mechanism and Inline functions.
- a. Call by reference, Call by Value, Call by Address
- b. Implementation of inline functions.

Experiment No. 5: Program to understand class and object.
- a. Program to differentiate between structure and class.
- b. Defining member functions inside and outside the class.

Experiment No. 6: Experiment on class and object continued…
- a. Program to implement array of objects.
- b. Implementation of static data members and member functions.

Experiment No. 7: Programs to Understand Friend Function & Friend Class.
- a. Friend Function
- b. Friend class

Experiment No. 8: Program to implement constructors and destructors.

Experiment No. 9: Programs to Implement Inheritance
- a. Single Inheritance (private and public mode derivation)
- b. Multiple Inheritances

Experiment No. 10: Programs to Implement Inheritance continued…

a. Hierarchical inheritance
b. Multilevel Inheritance
c. Multipath Inheritance

Experiment No. 11: Understanding static Polymorphism
a. Program to implement function overloading and its ambiguity.
b. overloading unary operators.
c. Programs to Overload Binary Operators.

Experiment No. 12: Program to implement dynamic polymorphism
a. Implementation of function overriding with virtual function
b. Use of this pointer

Course Outcomes:

CO1: The students will learn to write, compiling & execute basic C++ program.

CO2: The student will be able to create classes and objects and use them in their program.

CO3: The student will learn the use OOP concept i.e. data abstraction & data hiding.

CO4: The student will learn and use the inheritance.

CO5: The student will be able to use static and dynamic polymorphism.

Text Books:

T7. "Object Oriented Programming with C++", E. Balagurusamy, McGraw-Hill Education (India)
T8. "ANSI and Turbo C++", Ashoke N. Kamthane, Pearson Education

Reference Books:

R13. "C++: The Complete Reference", Schildt, McGraw-Hill Education (India)
R14. "Object Oriented Programming with C++", Rajiv Sahay, Oxford
R15. "Mastering C++", Venugopal, McGraw-Hill Education (India)

REF NO: To be filled by CD office

ME31310:: Fluid Machinery & Fluid Power Lab

Credits: 01 **Teaching Scheme:** Laboratory 02 Hrs/Week

Pre & Co-requisites:

1. Fluid Mechanics.
2. Fluid Machinery & Fluid Power Engineering.

Course Objectives:

The main objective of this Lab is to build a strong foundation and to acquaint the students with the

1. demonstration and verification of the integral momentum equation through impact of jet apparatus.
2. the operating characteristics of hydraulic turbines, and the factors affecting their operation and performance.
3. the operating characteristics of hydraulic pumps, and the factors affecting their operation and performance.
4. demonstration of some commonly used hydraulic components.
5. application of different ISO/GIS Fluid Power Symbols during analysis of hydraulic circuits.
6. analysis of Speed Control Circuit, Sequencing Circuit and Synchronizing Circuit in a hydraulic trainer kit.

Course Details:

List of Practical (*Any Ten*)

Experiment No. 1: Experiments on impact of Jets.

Experiment No. 2: Experiments on performance of Pelton Turbine.

Experiment No. 3: Experiments on performance of Francis Turbine.

Experiment No. 4: Experiments on performance of Kaplan Turbine.

Experiment No. 5: Experiments on performance of centrifugal pump.

Experiment No. 6: Experiments on performance of reciprocating pump.

Experiment No. 7: Experiments on performance of Gear Pump.

Experiment No. 8: Study of some commonly used hydraulic components (DCVs, Non-return valves, Flow control valves, Pressure control valves, Actuators) and their applications.

Experiment No. 9: Study of ISO/GIS Fluid Power Symbols

Experiment No. 10: Study of Speed Control Circuit on Hydraulic Trainer

Experiment No. 11: Study of Sequencing Circuit on Hydraulic Trainer

Experiment No. 12: Study of Synchronizing Circuit on Hydraulic Trainer

Course Outcomes: Students will be able to

CO1: demonstrate and verify the integral momentum equation through impact of water jet on flat or curved surfaces.

CO2: describe the operating characteristics of hydraulic turbines, and the factors affecting their operation and performance.

CO3: describe the operating characteristics of hydraulic pumps, and the factors affecting their operation and performance.

CO4: demonstrate some commonly used hydraulic components.

CO5: apply different ISO/GIS Fluid Power Symbols during analysis of hydraulic circuits.

CO6: analyze Speed Control Circuit, Sequencing Circuit and Synchronizing Circuit in a hydraulic trainer kit.

Text Books:

T9. "Hydraulics, Fluid Mechanics and Machinery", P N Modi and Seth, Standard Book House, 20th Edition, 2013.

T10. "Fluid Power with application", A Esposito, Prentice Hall, 7th Edition, 2014.

Reference Books:

R16. "Hydraulic Machines", R.K.Rajput, S.Chand Publications, 5th Edition, 1999.

R17. “Theory of Hydraulic Machinery”, V. P.Vasandani, Khanna Publishers, Paper Back Edition, 2010.
R18. Vickers Manual on Industrial Hydraulics, 5th Edition, 2008.
R19. “Hydraulic Machines”, J Lal, Metropolitan Book Co., Paper Back Edition, 1994.
R20. “Oil Hydraulics-Principle and Maintenance”, Majumdar, Tata McGraw Hill, 1st Edition, 2001.
R21. “Industrial Hydraulics”, J. H. Pipenger, McGraw Hill, 3rd Revised Edition, 1979.

Open Sources:

1. NPTEL: nptel.ac.in/courses/112104033/
2. MIT open course ware: http://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2008/lecture-notes/
3. annamalaiuniversity.ac.in/.../labmanual
4. https://www.iitg.ernet.in/mech/lab_ice.php

REF NO: To be filled by CD office

ME30308:: IC Engines Lab

Credits: 01 **Teaching Scheme:** Laboratory 02 Hrs/Week

Co-requisites:

6. Internal Combustion Engines

Course Objectives:

The main objective of this Lab is to build a strong foundation and to acquaint the students with the

7. performance analysis and load test of 2-S and 4-S engines.
8. preparation of heat balance sheet.
9. performance analysis of the variable compression ratio engine.
10. valve timing diagram of 2 stroke and 4 stroke I.C engines.
11. principle of operation of solex carburettor.
12. evaluation of exhaust smoke and exhaust emission in an exhaust gas analyzer.
13. understanding of types of Cooling system, Lubrication system.

Course Details:

List of Practical (*Any Ten*)

Experiment No. 1: Load test on 4-stroke single cylinder C.I. engine.

Experiment No. 2: Load test on 4-stroke single cylinder S.I. engine.

Experiment No. 3: Morse Test on multi-cylinder S.I. or C.I. engine.

Experiment No. 4: Load test on variable compression ratio S.I. engine.

Experiment No. 5: Load test and Heat balance on Multi Cylinder S.I. Engine.

Experiment No. 6: Valve timing diagram of an IC engine.

Experiment No. 7: Study of a modern carburetor (e.g. Solex Carburtor).

Experiment No. 8: Study of fuel injection system of a diesel engine.

Experiment No. 9: Analysis of exhaust gas of automobile.

Experiment No. 10: Study of different cooling systems in automobiles (Air cooling and water cooling).

Experiment No. 11: Study of lubrication systems in automobiles.

Course Outcomes: Students will be able to

CO1: analyze the performance of 2-S and 4-S engines and the variation of various performance parameters with load and speed.

CO2: prepare the heat balance sheet for an IC engine.

CO3: analyze the performance of the variable compression ratio engine with the understanding of pressure variation with crank angle during a cycle of operation.

CO4: demonstrate the complete operation of 2 stroke and 4 stroke I.C engines by drawing Valve Timing Diagram.

CO5: demonstrate principle of operation of Solex carburettor.

CO6: evaluate the exhaust smoke and exhaust emission characteristics.

CO7: demonstrate types of Cooling system, Lubrication system.

Text Books:

T11. "Fundamentals IC Engines", J.B.Heywood, McGraw Hill, Paper back Edition, 1989.

T12. "Internal Combustion Engines", V. Ganesan, TMH, 4th Edition,2012.

Reference Books:

R22. "IC Engines", Mathur & Sharma, Dhanpat Rai & Sons, Paper back Edition, 2010.

R23. "A course in IC Engines", V. M. Domkundwar, Dhanpat rai and sons, Paper back Edition, 2013.

R3. "Fundamentals of Internal Combustion Engines", H.N.Gupta, PHI, 2nd Edition, 2013.

R4. "Internal Combustion Engines" K K Ramalingam, Scitech, 2nd Edition, 2009.

R5. "Fundamentals of Internal Combustion Engines", Poul. W. Gill, James H. Smith, Jr. E.J.Zirus, Oxford, 4th Revised Edition, 2007.

Open Sources:

5. NPTEL: nptel.ac.in/courses/112104033/
6. MIT open course ware: http://ocw.mit.edu/courses/mechanical-engineering/2-61-internal-combustion-engines-spring-2008/lecture-notes/
7. annamalaiuniversity.ac.in/.../labmanual
8. https://www.iitg.ernet.in/mech/lab_ice.php

REF NO: To be filled by CD office

ME30309:: Mechanical Design Lab – I

Credits: 01 **Teaching Scheme: -** Laboratory 02 Hrs/Week

Pre & Co-requisites:

The Students should have knowledge of

5. Machine Drawing
6. Design of Machine Elements

Course Objectives:

6. To equip the students with the machine design fundamentals and the phases of design.
7. Create an understanding on the process of material selection and design.
8. To acquaint with the concepts of strength design related to various machine elements.
9. To design simple joints, couplings, fasteners, levers and springs.
10. To produce working drawings of the system involving various machine elements.

Course Details:

List of Design Practicals (*Any Six*)

Design **No. 1:** Design of Cotter joint

Design **No. 2:** Design of Knuckle joint

Design **No. 3:** Design of Riveted joint

Design **No. 4:** Design of Flange Coupling

Design **No. 5:** Design of Belt and Pulley

Design **No. 6:** Design of Lever

Design **No. 7:** Design of shafts subjected to combined loading

Design **No. 8:** Design of Helical Compression Spring

Design **No. 9:** Design and assembly drawing of screw jack with bill of materials

Course Outcomes:

The students will be able to

CO1: Explain basic principles in the design of machine elements & apply them effectively from material selection to design analysis using design data book to interpret standardized data.

CO2: Design and analyze permanent and temporary joints under various loading conditions.

CO3: Design and analyze power transmission shafts and couplings with different geometrical features under various loading conditions.

CO4: Explain various thread forms and design power screws.

CO5: Identify types of springs & levers and perform design analysis.

DESIGN DATA HAND BOOKS:

1. "Design Hand Book", S.M. Jalaluddin; Anuradha Agencies Publications
2. "P.S.G. Design Data Hand Book", PSG College of Tech Coimbatore
3. "Machine Design Data Book", K. Lingaiah, Tata McGraw Hill

TEXT BOOKS:

T13. "Mechanical Engineerng Design", J.E. Shigley, C.R. Mischke, R.G. Budynas and K.J. Nisbett, Tata McGraw-Hill , 8th Edition, 2008

T14. "Design of Machine Elements", V.B. Bhandari, Tata McGraw-Hill, 3rd Edition, 2010.

T15. "A Text Book of Machine Design", R.S. Khurmi and J.K. Gupta, S.Chand Publication, 14th Edition, 2005.

REFERENCE BOOKS:

R24. "Design of Machine Elements", M.F. Spotts, T.E. Shoup and L.E. Hornberger, Pearson/Prentice Hall, 8th Edition, 2007.

R25. "Machine Design", P.C. Sharma and D.K. Agrawal, S.K.Kataria & Sons, 11th Edition, 2007.

R26. "Machine Design", R.L. Norton, Pearson Education Asia, 5th Edition, 2001.

R27. "Fundamental of Machine Component Design", R.C. Juvinall and K.M. Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.

R28. "Machine Design", P. Kanaiah, Scietech Publications, 2nd Edition, 2008.

R29. "Machine Drawing", N.D. Bhatt and V.M. Panchal, Charotar Publishing House Pvt. Ltd, 49th Edition, 2014.

Third Year B.Tech Structure with effect from Academic Year 2017-18

MECHANICAL ENGINEERING

SEMESTER VI

Sl. No.	Code	Subject	Type	Teaching Scheme			Assessment Scheme						Credits
							ISA					ESA	
				L	P	T	Test	HA	T	Mid-Sem	CA	ESE	
S1	ME30113	Heat Transfer	Theory – Core	3	-	-	15	5	-	20	-	60	3
S2	MA31101	Computational Methods in Mechanical Engineering	Theory – Core / MD	3	-	1	10	5	5	20	-	60	4
S3	ME30114	Advance Mechanics of Solids	Theory – Core	3	-	1	10	5	5	20	-	60	4
S4	ME30115	Design of Machine Components	Theory – Core	3	-	-	15	5	-	20	-	60	3
S5	ME31116	Metal Cutting & Machine Tools	Theory – MD	3	-	-	15	5	-	20	-	60	2
P1	ME30313	Heat Transfer Lab	Lab – Core	-	2	-	-	-	-	-	70	30	1
P2	ME30315	Mechanical Design Lab - II	Lab – Core	-	2	-	-	-	-	-	70	30	1
P3	ME31366	Production & Dynamics Lab	Lab – MD / Core	-	2	-	-	-	-	-	70	30	1
P4	ME35367	Numerical Computation Lab	Lab – PD	-	2	-	-	-	-	-	70	30	1
MP	ME37398	Major Project- Stage I	Project	-	4	-	-	-	-	-	70	30	2
	ME37402	Comprehensive Viva Voce*	Oral	-	-	-	-	-	-	-	-	100	2
P5	IN37403	Pre-placement Training	Lab	-	2	-	-	-	-	-	100	-	1
			Total:	**15**	**14**	**2**							**25**

* Based on any two core theory subjects as recommended by the BoS. (**Heat Transfer, Metal Cutting & Machine Tools**)

L: Lecture, **P:** Practical, **T:** Tutorial, **ISA:** In-semester Assessment, **ESA:** End-semester Assessment, **HA:** Home Assignment, **CA:** Continuous Assessment (for practical), **ESE:** End-semester Examination, **MD:** Multi-disciplinary, **PD:** Professional Development

REF NO: To be filled by CD office

ME30114:: Advanced Mechanics of Solids

Credits: 03 **Teaching Scheme: -** Theory 03 Hrs/Week

Prerequisites: Mechanics of Solids

Course Objectives:

The main objective of the course is to build a strong foundation and to acquaint the students with the

1. determination of the deflection produced in a beam by energy method.
2. analysis of stress and strain of curved beams and thick cylindrical pressure vessels.
3. analysis of three dimensional stresses in solids.
4. analysis of three dimensional strains in solids
5. mechanics of composite materials.

Course Details:

Unit 1: Energy Methods (09 Hrs)

U1.1. Elastic strain energy due to normal stress and shearing stress, Principle of virtual work, Unit load and unit couple method, Castigliano's theorem and its application to beams.

U1.2. Maxwell's reciprocal theorem, Betti-Rayleigh reciprocal theorem.

Unit 2: Bending of Beams and Axisymmetric Problems (13 Hrs)

U2.1. Bending of beams: Unsymmetrical bending of beams, Bending of curved beams, Stress distribution in curved beams with rectangular, circular and trapezoidal cross section, Stresses in crane hooks, Shear centre.

Axisymmetric problems: Thick walled cylinder subjected to internal and external pressures, Compound cylinders, Shrink fit.

U2.2. Stresses in ring and chain links, Deflection of thick curved bars.

Unit 3: Three Dimensional Stress Analysis (07 Hrs)

U3.1. Elementary concept of elasticity, stresses in three dimensions, Principal Stresses, Stress Invariants, Mohr's Circle for 3-D state of stress, Octahedral Stresses, State of pure shear.

U3.2. Differential equations of equilibrium.

Unit 4: Three Dimensional Strain Analysis (05 Hrs)

U4.1. Displacement field, State of strain at a point, Strain-Displacement relations, Principal Strains, strain Invariant, Principal directions.

U4.2. Strain-Compatibility relations.

Unit 5: Introduction to Mechanics of Composite Materials (06 Hrs)

U5.1. Introduction to composite materials, Applications, Stress-strain relations, Basic cases of elastic symmetry, Micromechanical behavior of a lamina

U5.2. Macromechanical behavior of a lamina.

Course Outcomes: Students will be able to

CO1: determine the deflection produced in a beam by energy method.

CO2: perform stress and strain analysis of curved beams and thick cylindrical pressure vessels.

CO3: analyze three dimensional stresses in solids.

CO4: analyze three dimensional strains in solids.

CO5: explain the mechanics of composite materials.

Text Books:

T1. "Advanced Mechanics of Solids", L.S. Srinath, Tata McGraw-Hill Publishing Company Limited, Third Edition, 2009.

T2. "Advanced Mechanics of Materials", A.P.Boresi and R.J. Schmidt, John Wiley & Sons, Sixth Edition, 2003.

T3. "Advanced Mechanics of Materials", K. Kumar and R.C. Ghai, Khanna

Publisher, Seventh Edition, 2008.

Reference Books:

R1. “Mechanics of Materials”, Ferdinand P. Beer, E. Russell Johnston Jr., Johnston T. DeWolf, and David F. Mazurek, Tata Mcgraw Hill Education Private Limited, Fifth Edition, 2011.
R2. “Mechanics of Composite Materials”, R.M. Jones, Taylor & Francis, Second Edition, 1999.
R3. “Strength of Materials”, Dr. Sadhu Singh, Khanna Publishers, Eleventh Edition, 2014.
R4. “Mechanics of Materials”, R.C Hibbeler, Printice Hall, Ninth Edition, 2013.
R5. “Strength of Materials”, S.S Ratan, Tata Mcgraw Hill Education Private Limited, Second Edition, 2008.

Open sources:

- http://nptel.ac.in
- http:// ocw.mit.edu/courses/mechanical-engineering/
- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

ME30114:: Advanced Mechanics of Solids

Credits: 01 **Teaching Scheme: -** Tutorial 01 Hr/Week

Prerequisites: Mechanics of Solids

Course objectives:

The main objective of the course is to build a strong foundation and to acquaint the students with the

1. determination of the deflection produced in a beam by energy method.
2. analysis of stress and strain of curved beams and thick cylindrical pressure vessels.
3. analysis of three dimensional stresses in solids.
4. analysis of three dimensional strains in solids
5. mechanics of composite materials.

Course Details:

List of Contents

Tutorial No. 1: Numericals on Virtual work method.

Tutorial No. 2: Numericals on Castigliano's theorem.

Tutorial No. 3: Numericals on Unsymmetrical bending.

Tutorial No. 4: Numericals on Curved beams.

Tutorial No. 5: Numericals on Crane hook.

Tutorial No. 6: Numericals on Shear centre.

Tutorial No. 7: Numericals on Thck cylinders.

Tutorial No. 8: Numericals on Three dimensional stress analysis of solids.

Tutorial No. 9: Numericals on Three dimensional strain analysis of solids.

Tutorial No. 10: Numericals on Macromechanics and Micromechanics of a lamina.

Course Outcomes: Students will be able to

CO1: determine the deflection produced in a beam by energy method.

CO2: perform stress and strain analysis of curved beams and thick cylindrical pressure vessels.

CO3: analyze three dimensional stresses in solids.

CO4: analyze three dimensional strains in solids.

CO5: explain the mechanics of composite materials.

Text Books:

T1. "Advanced Mechanics of Solids", L.S. Srinath, Tata McGraw-Hill Publishing Company Limited, Third Edition, 2009.

T2. "Advanced Mechanics of Materials", A.P.Boresi and R.J. Schmidt, John Wiley & Sons, Sixth Edition, 2003.

T3. "Advanced Mechanics of Materials", K. Kumar and R.C. Ghai, Khanna Publisher, Seventh Edition, 2008.

Reference Books:

R1. "Mechanics of Materials", Ferdinand P. Beer, E. Russell Johnston Jr., Johnston T. DeWolf, and David F. Mazurek, Tata Mcgraw Hill Education Private Limited, Fifth Edition, 2011.

R2. "Mechanics of Composite Materials", R.M. Jones, Taylor & Francis, Second Edition, 1999.

R3. "Strength of Materials", Dr. Sadhu Singh, Khanna Publishers, Eleventh Edition, 2014.

R4. "Mechanics of Materials", R.C Hibbeler, Printice Hall, Ninth Edition, 2013.

R5. "Strength of Materials", S.S Ratan, Tata Mcgraw Hill Education Private Limited, Second Edition, 2008.

REF NO: To be filled by CD office

MA31101:: Computational Methods in Mechanical Engineering

Credits: 03 **Teaching Scheme: -** Theory 03 Hrs/Week

Prerequisites: Elementary idea of differential and integral calculus of 10+2 standard.

Course Objectives:

1. To enlighten the students with the different numerical techniques to interpolate a set of data points to a polynomial (known as interpolating polynomial).
2. To enlighten the students with the different numerical techniques to find eigen values of matrices.
3. To make students aware of numerical techniques to solve algebraic and transcendental equations
4. To make students aware of the techniques of Numerical Integration and Numerical Differentiation.
5. To make students aware of single and multi – step numerical methods to solve initial value problems involving ordinary differential equations.
6. To make students aware of finite difference schemes to solve partial differential equations.

Course Details:

Unit 1

Numerical solution of Transcendental Equations: (08 Hrs)

U1.1. Numerical methods: Approximation and round of errors, Truncation error and Taylor's series.
Roots of equation: The bisection method, the false-position method, fixed point iteration, Newton-Raphson method, Muller's method, Secant Method. **[T_1]**

U1.2. Finding Multiple Roots

Unit 2

Interpolation and Numerical Integration: (08 Hrs)

U2.1. Interpolation: Newton divided difference interpolation, Lagrange Interpolation, Newton's forward and backward interpolation. **[T_3]**

Numerical integration: The trapezoidal rule, The Simpson's 1/3rd and 3/8th rules, Gauss quadrature (Two Point Formula), Romberg Integration Method. **[T_1]**

U2.2. Central difference methods of interpolation and Gauss Quadrature, Three Point Formula

Unit 3

Eigen Values and Eigen Vectors and Solution of System of Linear Equations: (08 Hrs)

U3.1 Eigen Values and Eigen Vectors: Basic power method, Rayleigh Quotient, Shifted power method, Inverse power method, QR method. **[T_2]**

Solution of System of Linear Equations: Guass-Siedel Method. **[T_1]**

U3.2 Solution of system of Linear equations by Newton-Raphson Method

Unit 4

Numerical Differentiation and Numerical Solutions of Ordinary Differential Equations: (08 Hrs)

U4.1. Numerical Differentiation: Forward and Backward Difference Methods. **[T_1]**

Numerical Solutions of Ordinary differential equations: Taylor Series Method, Euler Method, Modified Euler Method, Runge Kutta Runge-Kutta methods – 2nd and 4th order Methods, Predictor-Corrector Methods – ABM2, ABM3, ABM4, Milne's Methods. **[T_2, T_4]**

U4.2. Numerical Differentiation using Central methods, Runge Kutta higher order methods.

Unit 5

Numerical Solutions of Partial Differential Equations: (08 Hrs)

U5.1. Finite Difference Methods: Elliptic Equations – [Laplace's and Poisson's Equations], Parabolic Equations [Heat Equations], Hyperbolic Equations [Wave Equations]. **[T_4]**

U5.2. Solution of Elliptic Partial Differential Equations by Finite Difference Schemes.

Course Outcomes:

The student will be able to

CO1: Formulate engineering problems into Mathematical equations and find the solution

CO2: Apply various numerical methods like Newton Raphson, Bisection, and Regula Falsi to find the roots of an equation.

CO3: Apply numerical methods like Gauss Seidel to find the solution of Linear Simultaneous equations.

CO4: Interpret experimental data by using Interpolation

CO5: Get approximate solutions of ODE's by using Numerical approach.

CO6: Get approximate solutions of PDE's by using Finite Difference Schemes.

CO7: Find eigen values and eigen vectors of matrices using Numerical Methods.

Text Books:

T1. Numerical methods for Engineers, Steven C. Chapra and Raymond P. Canale, Tata McGraw-Hill Publishing Company Limited, New Delhi,, Fifth Edition,2007.
Chapters 2, 3(3.1, 3.2), 4(4.2, 4.3), 5 (5.1, 5.2, 5.3), 6 (6.4), 10(10.2), 16(16.1, 16.2), 17(17.2, 17.3), 18 (18.1).

T2. Applied Numerical Analysis Using MATLAB, Laurene V. Fausett, Pearson Education, Second Edition,2 011.
Chapters: 4(4.3), 5(5.1(5.1.1 – 5.1.3), 5.2(5.2.1), 5.3(5.3.1), 12(12.3 (12.3.1 – 2.3.4)).

T3. Numerical Methods For Scientific and Engineering Computation, M. K. Jain, S. R. K. Iyengar, R.K. Jain, New Age International Publishers, Sixth Edition, 2014.
Chapters: 4(4.1 – 4.4).

T4. Introductory Method of Numerical Analysis, S. S. Sastry, PHI Learning PVT LTD, New Delhi, Fourth Edition, 2009.
Chapters: 7(7.1, 7.2, 7.4, 7.5), 8(8.1 – 8.6).

Reference Books:

R1. Numerical Analysis and Computational Procedures, S. A. Mollah, Books and Allied (P) Limited, Fifth Edition, 2013.

R2. Advanced Engineering Mathematics, Erwin Kreyszig, John Willy and Sons, 8th Edition, 1999.

R3. Numerical Mathematics and Computing, W.Cheney and D. Kincaid, Thomson/CENGAGE Learning, Fifth Edition, 2014.

R4. Numerical Methods for Engineers, S.K.Gupta, New Age International, Second Edition, 1995.

R5. Applied numerical methods with MATLAB, Steven C. Chapra, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition, 2007.

R6. Applied Numerical Methods for Engineering, R.J. Schilling and S.L.Harris, CENGAGE learning, 2000.

R7. Numerical Solution of Differential Equations, M. K. Jain, New Age International (P) Limited, Publishers, 2nd Edition, 2002.
R8. Numerical Methods, E. Balagurusamy, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 25th Reprint, 2008.
R9. Theory and Problems in Numerical Methods with programs in C and C++, T. Veerarajan and T. Ramchandran, Tata McGraw Hill Co. Ltd. New Delhi, 2nd Edition, 2006.
R10. Applied Numerical Methods, A. Gourdin and M. Boumahrat, Prentice Hall of India Ltd, New Delhi, 2004

REF NO: To be filled by CD office

MA31101:: Computational Methods in Mechanical Engineering

Credits: 01 **Teaching Scheme: -** Tutorial 01 Hrs/Week

Prerequisites: Elementary idea of differential and integral calculus of 10+2 standard.

List of Contents

Tutorial No. 1: Problems involving the bisection method, the false-position method, fixed point iteration, Newton - Raphson method,
Tutorial No. 2: Problems for practice on Muller's method and Secent Method**.**
Tutorial No. 3: Some problems for practice involving Interpolation
Tutorial No. 4: Some problems for practice involving Numerical Integration Methods.
Tutorial No.5: Problems for practice on finding eigen values of matrices by numerical methods.
Tutorial No. 6: Problems for practice on Guass Siedel Methods.
Tutorial No. 7: Some problems for practice on single-step methods to solve ordinary differential equations.
Tutorial No. 8: Some problems for practice on ABM2, ABM3, ABM4 methods to solve ordinary differential equations.
Tutorial No. 9: Some problems for practice on Milne's methods to solve ordinary differential equations.
Tutorial No. 10: Some problems for practice involving Parabolic PDE.
Tutorial No. 11: Some problems for practice involving Hyperbolic PDE.
Tutorial No. 12: Some problems for practice involving Elliptic PDE.

Course Outcomes:

The student will be able to

CO1: Formulate engineering problems into Mathematical equations and find the solution

CO2: Apply various numerical methods like Newton Raphson, Bisection, and Regula Falsi to find the roots of an equation.

CO3: Apply numerical methods like Gauss Seidel to find the solution of Linear Simultaneous equations.

CO4: Interpret experimental data by using Interpolation

CO5: Get approximate solutions of ODE's by using Numerical approach.

CO6: Get approximate solutions of PDE's by using Finite Difference Schemes.

CO7: Find eigen values and eigen vectors of matrices using Numerical Methods.

Text Books:

T1. Numerical methods for Engineers, Steven C. Chapra and Raymond P. Canale, Tata McGraw-Hill Publishing Company Limited, New Delhi,, Fifth Edition,2007.
Chapters 2, 3(3.1, 3.2), 4(4.2, 4.3), 5 (5.1, 5.2, 5.3), 6 (6.4), 10(10.2), 16(16.1, 16.2), 17(17.2, 17.3), 18 (18.1).

T2. Applied Numerical Analysis Using MATLAB, Laurene V. Fausett, Pearson Education, Second Edition,2 011.
Chapters: 4(4.3), 5(5.1(5.1.1 – 5.1.3), 5.2(5.2.1), 5.3(5.3.1), 12(12.3 (12.3.1 – 2.3.4)).

T3. Numerical Methods For Scientific and Engineering Computation, M. K. Jain, S. R. K. Iyengar, R.K. Jain, New Age International Publishers, Sixth Edition, 2014.
Chapters: 4(4.1 – 4.4).

T4. Introductory Method of Numerical Analysis, S. S. Sastry, PHI Learning PVT LTD, New Delhi, Fourth Edition, 2009.
Chapters: 7(7.1, 7.2, 7.4, 7.5), 8(8.1 – 8.6).

Reference Books:

R1. Numerical Analysis and Computational Procedures, S. A. Mollah, Books and Allied (P) Limited, Fifth Edition, 2013.

R2. Advanced Engineering Mathematics, Erwin Kreyszig, John Willy and Sons, 8th Edition, 1999.

R3. Numerical Mathematics and Computing, W.Cheney and D. Kincaid, Thomson/CENGAGE Learning, Fifth Edition, 2014.

R4. Numerical Methods for Engineers, S.K.Gupta, New Age International, Second Edition, 1995.

R5. Applied numerical methods with MATLAB, Steven C. Chapra, Tata McGraw-Hill Publishing Company Limited, New Delhi, Second Edition, 2007.

R6. Applied Numerical Methods for Engineering, R.J. Schilling and S.L.Harris, CENGAGE learning, 2000.

R7. Numerical Solution of Differential Equations, M. K. Jain, New Age International (P) Limited, Publishers, 2nd Edition, 2002.

R8. Numerical Methods, E. Balagurusamy, Tata McGraw Hill Pub. Co. Ltd., New Delhi, 25th Reprint, 2008.

R9. Theory and Problems in Numerical Methods with programs in C and C++, T. Veerarajan and T. Ramchandran, Tata McGraw Hill Co. Ltd. New Delhi, 2nd Edition, 2006.

R10. Applied Numerical Methods, A. Gourdin and M. Boumahrat, Prentice Hall of India Ltd, New Delhi, 2004

REF NO: To be filled by CD office

ME30115:: Design of Machine Components

Credits: 03 **Teaching Scheme: -** Theory 03 Hrs/Week

Prerequisites:

7. Design of Machine Elements
8. Dynamics of Machines

Course Objectives:

1. To familiarize with the design process for variable loading conditions.
2. To study selection of rolling element bearing and design of hydrodynamic bearing.
3. To gain knowledge on the principles and procedure for the design of mechanical power transmission and IC engine components.
4. To create an understanding on the design process of pressure vessels.
5. To learn to use standard data and catalogues

Course Details:

Unit 1: Design for Variable Loading (08 Hrs)

U1.1 Concept of stress concentration, Notch sensitivity, Methods of relieving stress concentration, Concept of fatigue, Types of Fatigue loading, Fatigue cycle regimes, Failure models, S-N Curve for reversed loading, Soderberg, Modified Goodman and Gerber design criteria, Design against fluctuating normal, shear and combined stresses.

U1.2 Fatigue test methods, Cumulative fatigue.

Unit 2: Design of Bearings (10 Hrs)

U2.1 Function and classification

Lubrication: Hydrostatic and Hydrodynamic lubrication, Lubricants, Viscosity chart.

Sliding Contact Bearing: Types, Description of Journal bearing, Raimondi & Boyd method for design of journal bearing.

Rolling Contact Bearing: Types, Structural features, Design considerations, Static LCC, Rating life, Dynamic LCC, Selection of Ball and Cylindrical roller bearings, Design for different confidence levels and variable loading.

U2.2 Pedestal bearing, Foot step bearing.

Unit 3: Design of transmission members (12 hrs)

U3.1 **Spur Gears**: Standard tooth systems, Force analysis, Tooth failure, Strength design, Wear design.
Helical Gears: Kinematics, Virtual number of teeth, Force analysis, Tooth failure, Strength design, Wear design.

Friction Clutches: Design of Disc clutch, Cone clutch and Centrifugal clutch.

Brakes: Design of Block and Band brake, Internal expanding shoe brake.

U3.2 Types of gears, Gear materials and manufacturing methods, Electromagnetic clutch Disc brake.

Unit 4: Design of IC Engine Components (06 hrs)

U4.1 **Design of Piston**: Design considerations, Materials, Design of piston head or crown, Piston rings, Piston barrel, Piston skirt, Piston pin.
Design of Connecting Rod: Description, Forces analysis, Dimensions of cross section, Design of crank pin and piston pin, Size of bolt used for big end cap, Thickness of big end cap.

Design of Flywheel: Construction, Rim dimensions, Stresses in flywheel rim and arms.

U4.2 Design of cylinder, Design of crank shaft.

Unit 5: Design of Pressure Vessels (04 hrs)

U5.1 Thin cylinder and spherical shells, Thick cylinder shells, Application to practical problems.
U5.2 End closures, Autofrettage

Course Outcomes:

The students will be able to

CO1: Analyze life of components under fatigue loading.

CO2: Analyze operating conditions of Journal bearings, and use manufacturer's catalogue for selection of rolling contact bearings.

CO3: Identify, evaluate, compare and design different power transmission and absorption components like gears, clutches, and brakes.

CO4: Perform strength design of IC engine components.

CO5: Explain pressure vessels and their design.

DESIGN DATA HAND BOOKS:

1. "Design Hand Book", S.M. Jalaluddin, Anuradha Agencies Publications
2. "P. S. G. Design Data Hand Book", PSG College of Tech Coimbatore
3. "Machine Design Data Book", Abdulla and Sharrif, Khanna Publications.

TEXT BOOKS:

T16. "Mechanical Engineerng Design", J.E. Shigley, C.R. Mischke, R.G. Budynas and K. J. Nisbett, Tata McGraw-Hill , 8th Edition, 2008

T17. "Design of Machine Elements", V.B. Bhandari, Tata McGraw-Hill, 3rd Edition, 2010.

T18. "A Text Book of Machine Design", R. S. Khurmi and J. K. Gupta, S. Chand Publication, 14th Edition, 2005.

REFERENCE BOOKS:

R30. "Design of Machine Elements", M. F. Spotts, T. E., Shoup, & L. E. Hornberger, Pearson/Prentice Hall, 8th Edition, 2007.

R31. "Machine Design", P.C. Sharma and D. K. Agrawal, S. K. Kataria & Sons, 11th Edition, 2007.

R32. "Machine Design", Robert L. Norton, Pearson Education Asia, 5th Edition, 2001.

R33. "Fundamental of Machine Component Design", Robert C. Juvinall and Kurt M Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007

R34. "Machine Design", P.Kanaiah, Scietech Publications, 2nd Edition, 2008

R35. "Design of Transmission Elements", Prabhu T.J., Mani Offset, Chennai, 2000.

R36. "Machine Design", Design of Transmission Systems, U. C. Jindal, Dorling, Kindersley, 2010.

Open sources:

- http://nptel.ac.in
- http:// ocw.mit.edu/courses/mechanical-engineering/
- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

ME30113:: Heat Transfer

Credits: 03 **Teaching Scheme:** Theory 03 Hrs/Week

Prerequisites:

7. Basic Thermodynamics
8. Fluid Mechanics
9. Mathematics I
10. Mathematics II
11. Mathematics III(B) (Partial Differential Equation & Complex Analysis)

Course Objectives:

The main objective of this subject is to build a strong foundation and to acquaint the students with the

1. understanding of basic laws of heat transfer and their application in thermal analysis of engineering systems for different boundary conditions.
2. determination of temperature distribution in simple geometries using steady state heat conduction equation.
3. performance analysis of fins and development of solutions for transient heat conduction in simple geometries.
4. analysis and application of empirical correlations for solution of heat transfer problems in convection, boiling and condensation.
5. analysis and design of heat exchanger by LMTD and NTU method.
6. evaluation of radiative heat transfer between surfaces.

Course Details:

Unit 1: Introduction (5Hrs)

U.1.1. Modes of heat transfer: Conduction, Convection, and Radiation ,Mechanism & basic laws governing conduction, convection, and radiation heat transfer; Thermal conductivity, Thermal conductance & thermal resistance, Contact resistance, convective heat transfer

coefficient, radiation heat transfer coefficient, Electrical analogy, combined modes of heat transfer, Initial conditions and Boundary conditions of 1st, 2nd and 3rd kind.

U1.2. Thermal Conductivity in metal and non metals, liquids and gases.

Unit 2: One Dimensional Heat Conduction (5 Hrs)

U2.1. General heat conduction in Cartesian co-ordinates, Simplification of the general equation for one and two dimensional steady/ transient conduction with constant/ variable thermal conductivity with / without heat generation, Solution of the one dimensional steady state heat conduction problem in case of plane walls, cylinders and spheres for simple and composite cases, Critical insulation thickness.

U2.2. Generalized heat conduction equation in cylindrical and spherical coordinates.

Unit 3: Heat transfer from extended surfaces and Lumped system analysis (5 Hrs)

U3.7. Heat transfer from extended surfaces (pin fins only) without heat generation, Long fin, short fin with insulated tip and without insulated tip and fin connected between two heat sources. Fin efficiency and fin effectiveness, Conduction in solids with negligible internal temperature gradient (Lumped heat analysis), Solution of Cartesian problems in two dimensions (steady state conduction with constant thermal conductivity and no heat generation) by variable separation method, Numerical methods for heat conduction analysis.

U3.8. Variable separation method for solving 2D heat conduction, Gauss-Seidel method.

Unit 4: Convection, Boiling and Condensation (15 Hrs)

U4.7. Mechanism of convection, boundary layer fundamentals.

Forced Convection (External): Conservation of mass, momentum and energy equation for 2-D laminar flow over a flat plate. Reynolds-Coulbourn analogy for Turbulent flow over a flat plate. Use of empirical relations for solving turbulent conditions for external flow.

Forced Convection (Internal): Forced Convection inside tubes and ducts (velocity and temperature profiles). Analysis of laminar forced convection inside a tube. Evaluation of heat transfer coefficients for laminar flow (Constant heat flux

and constant temperature). Use of empirical relations for solving flow inside circular and non-circular tubes.

Natural Convection: Mechanism of heat transfer during natural convection, Experimental heat transfer correlations for natural convection in the following cases (a) Vertical and horizontal plates (b) Inside and outside flows in case of tubes.

Condensation and Boiling: Film wise and drop wise condensation – Film condensation on a vertical plate – Regimes of Boiling – Forced convection boiling.

U4.8. Classification of fluid flows, Drag and heat transfer in external flow.

Unit 5: Radiation and Heat exchangers (10 Hrs)

U5.1. Radiation: Introduction to radiation, Radiation Intensity, Laws of radiation: Planck's law, Wein's displacement law and Stefan Boltzmann law, Kirchhoff's law, Radiative properties, Concepts of black body & grey body, View factor, Electrical analogy, Radiation exchange between surfaces, Radiation shield.

Heat Exchangers: Types and practical applications, use of LMTD & Effectiveness – NTU method, fouling factor.

U5.2. Practical applications of heat exchangers, Solar radiation.

Course Outcomes: Students will able to

CO1: understand the basic laws of heat transfer and their application in thermal analysis of engineering systems for different boundary conditions.

CO2: determine temperature distribution in simple geometries using steady state heat conduction equation.

CO3: analyze the performance of fins and develop solutions for transient heat conduction in simple geometries.

CO4: analyze and apply empirical correlations for solution of heat transfer problems in convection, boiling and condensation.

CO5: analyze and design heat exchanger by LMTD and NTU method.

CO6: evaluate the radiative heat transfer between surfaces.

Text Books:

T1. "Heat Transfer", P. K. Nag, TMH, 3rd Edition, 2011.

T2. "Heat Transfer", J. P. Holman, TMH, 9th Edition, 2008.

T3. **"**Basic Heat Transfer", Necati Ozisik, McGraw Hill Publication, 1984.

Reference Books:

R1. "Heat Transfer", P. S. Ghosdastidar, Oxford University Press, 2nd Revised Edition, 2012.

R2. "Heat Transfer", S. P. Sukhatme, University Press, 2006.

R3. "Heat Transfer", A. F. Mills and V. Ganesan, Pearson Education, 2nd Edition, 1992.

R4. "Heat and Mass Transfer", Domkundwar and Arora, Danpatrai and sons, Paper Back Edition, 2005.

R5. "Heat Transfer", R.K.Rajput, S. Chand Publications, Revised Edition, 2012.

R6. "Heat and Mass Transfer - A Practical Approach", Y. A. Cengel, Tata McGraw Hills, 3rd Revised Edition, 2006.

R7. "Fundamentals of Heat and Mass Transfer", Incropera and DeWitt, Wiley Publication, 6th Edition, 2010.

Open Sources:

- NPTEL: nptel.ac.in/courses/112101097/
- MIT open course ware: http://ocw.mit.edu/courses/mechanical-engineering/2-51-intermediate-heat-and-mass-transfer-fall-2008/study-materials/

REF NO: To be filled by CD office

ME31116:: Metal Cutting & Machine Tools

Credits: 02 **Teaching Scheme:** Theory 03 Hrs/Week

Prerequisites:

1. Material Science
2. Basic Manufacturing Processes
3. Production Metallurgy

Course Objectives:

The main objective of the course is build to a strong foundation and to acquaint the students with the

1. mechanism of theory of metal cutting.
2. various types of machine tool and their operations.
3. different gear manufacturing processes and surface finishing processes.
4. concepts of non-traditional machining.
5. understanding of CNC and part programming.

Course Details:

Unit 1: Theory of Metal Cutting (10 Hrs)

U1.8. Orthogonal and oblique cutting, Classification of cutting tools: single, multipoint, Tool signature for single point cutting tool, Mechanics of orthogonal cutting, Force and Velocity relations, Merchant circle, Determination of Shear angle ,Chip formation, Cutting tool materials, Tool wear and tool life, Machinability, Cutting Fluids, Measurement of cutting forces.

U1.9. Lathe tool dynamometer, Drill tool dynamometer, Economics of machining.

Unit 2: Constructional Features and Specifications of Machine Tools (09 Hrs)

U2.1. Various operations on Lathe, Types of Lathes, capstan and turret Lathes, automatic

Lathes, Gear box design (structural and ray diagram), Drilling machine, Milling machine, Indexing methods, Differences Between shaper, planer and slotter, Tool holding and work holding devices. Quick return mechanism, Automatic feed devices, Tool materials, Machining time calculations.

U2.2. Feed motion mechanisms, Nomenclature of drill, Milling cutter, Broach, Reamer.

Unit 3: Gear Manufacturing, Surface Finishing & Super finishing Processes (09 Hrs)

U3.9. Gear manufacturing processes: Extrusion, Stamping, Gear Machining: Forming, Gear generating process - Gear shaping, Gear hobbing. Surface Finishing Process: Grinding process, various types of grinding machine, Grinding Wheel - types - Selection of Cutting speed and work speed, dressing and truing. Fine Finishing - Lapping, Buffing, Honing, and Super finishing.

U3.10. Thread manufacturing, burnishing and brushing.

Unit 4: Introduction to Non-traditional Machining (04 Hrs)

U4.9. Principle and applications of USM, AJM, ECM, EDM, EBM.

U4.10. Principle and applications of WJM, WEDM, Chemical Milling & Grinding.

Unit 5: CNC Machine Tools (04 Hrs)

U5.5. CNC Machines, working principle, classification, constructional features of CNC machines, CNC controller, types of motion controls in CNC machines, applications of CNC machines

U5.6. CNC Machining Centres, Part Programming

Course Outcomes: Students will be able to

CO1: understand the mechanism of theory of metal cutting.

CO2: familiarize with the various type of machine tool and their operations.

CO3: learn about different gear manufacturing process and surface finishing process.

CO4: acquire the concepts of non-traditional machining.

CO5: familiarize with CNC machines and part programming.

Text Books:

T1 "Manufacturing Technology Volume II", P.N.Rao, McGraw Hill Education (India)

Private limited, 3rd Edition, 2013,
T2 “A text Book of production Engineering”, P.C.Sharma, S. Chand & Company Pvt. Limited, 5th Edition, 2010.
T3 “Manufacturing Engineering and Technology”, S. Kapakjian and S.R. Schmid, Pearson Education (Singapore) Pvt. Ltd., 6th Edition, 2010.
T4 “CAD/CAM Principles and Applications”; P. N. Rao, Tata McGraw Hill Publishing Company Limited, 1st Edition, 2002.

Reference Books:

R1 "Fundamentals of Metal Machining and Machine Tools", Geofrey Boothroyd, Mc Graw Hill, 3rd Edition, 1984.
R2 “Workshop Technology Vol. I and II”, Chapman.W.A.J,Arnold Publisher, New Delhi, 5th Edition, 2001.
R3 “Manufacturing Science”, A Ghosh and A K Mallick, Affiliated East West Press , 2nd Edition, 1985.
R4 "Introduction to Jigs and fixtures design”, M.H.A. Kempster, Hodder and Stoughton, 3rd Edition, 1974.
R5 “Machining and Machine Tools”, A B Chattopadhayay, Wiley, 3rd Edition, 2011.

Open sources:

- http://nptel.ac.in
- http:// ocw.mit.edu/courses/mechanical-engineering/
- http://www.myopencourses.com/discipline/mechanical-engineering

REF NO: To be filled by CD office

ME30313:: Heat Transfer Lab

Credits: 01 **Teaching Scheme:** Laboratory 02 Hrs/Week

Co-requisites:

12. Heat Transfer.

Course Objectives:

The main objective of this lab is to build a strong foundation and to acquaint the students with the

1. analysis of heat transfer by conduction in various commonly used materials.
2. measurement of the fin performance under natural/ forced convection.
3. fundamental difference between external and internal flow.
4. performance analysis of heat exchangers.
5. concept of pool boiling.
6. experimental work in radiative heat transfer.

Course Details:

List of Practical (*Any Ten*)

Experiment No. 1: Determination of Thermal conductivity of composite slab.

Experiment No. 2: Determination of thermal conductivity of insulating powder.

Experiment No. 3: Efficiency and effectiveness of fins (Natural convection).

Experiment No. 4: Efficiency and effectiveness of fins (Forced convection).

Experiment No. 5: Natural convection heat transfer from a heated vertical cylinder.

Experiment No. 6: Heat transfer in forced convection for internal flow in a pipe.

Experiment No. 7: Performance of a parallel flow and counter flow heat exchanger.

Experiment No. 8: Performance of shell and tube heat exchanger.

Experiment No. 9: Determination of critical heat flux.

Experiment No. 10: Verification of Stefan Boltzmann's law.

Experiment No. 11: Determination of surface emissivity.

Course Outcomes: Students will be able to

CO1: analyze heat transfer by conduction in various commonly used materials.

CO2: measure the fin performance under natural/ forced convection.

CO3: demonstrate the fundamental difference between external and internal flow.

CO4: measure the amount of heat transfer taking place between fluids flowing within heat exchangers.

CO5: demonstrate the concept of pool boiling.

CO6: demonstrate fundamental concepts of radiative heat transfer.

Text Books:

T1. "Heat Transfer", P.K. Nag, TMH, 3rd Edition, 2011.

T2. "Heat Transfer", J. P. Holman, TMH, 9th Edition, 2008.

T3. **"**Basic Heat Transfer", Necati Ozisik, McGraw Hill Publication, 1984.

Reference Books:

R1. "Heat Transfer", P.S. Ghosdastidar, Oxford University Press, 2nd Revised Edition, 2012.

R2. "Heat Transfer", S.P. Sukhatme, University Press, 2006.

R3. "Heat Transfer", A.F.Mills and V.Ganesan, Pearson Education, 2nd Edition, 1992.

R4. "Heat and Mass Transfer", Domkundwar and Arora, Danpatrai and sons, Paper Back Edition, 2005.

R5. "Heat Transfer", R.K.Rajput, S. Chand Publications, Revised Edition, 2012.

R6. "Heat and Mass Transfer- A Practical Approach", Y.A.Cengel, Tata McGraw Hills, 3rd Revised Edition, 2006.

R7. "Fundamentals of Heat and Mass Transfer" Incropera and DeWitt, Wiley Publication, 6th Edition, 2010.

Open Sources:

9. NPTEL: nptel.ac.in/courses/112101097/
10. MIT open course ware: http://ocw.mit.edu/courses/mechanical-engineering/2-51-intermediate-heat-and-mass-transfer-fall-2008/study-materials/
11. home.iitk.ac.in/~panig/ME341
12. www.nitw.ac.in/departments/mech/index.../heat-and-mass-transfer-lab-2/
13. www.academia.edu/.../A_Manual_for_MECH_3355

REF NO: To be filled by CD office

ME30315:: Mechanical Design Lab – II

Credits: 01 **Teaching Scheme: -** Laboratory 02 Hrs/Week

Co-requisites:

9. Design of Machine Components

Course Objectives:

The main objective of the course is to build a strong foundation and to acquaint the students with the

6. design process for variable loading conditions.
7. selection of rolling element bearing and design of hydrodynamic bearing.
8. principles and procedure for the design of mechanical power transmission and IC engine components.
9. design process of pressure vessels.
10. working drawings of the system involving various components.

Course Details:

List of Design Practicals (*Any six*)

Design **No. 1:** Design of clutch

Design **No. 2:** Design of brake

Design **No. 3:** Design of flywheel

Design **No. 4:** Design of Piston

Design **No. 5:** Design of Connecting rod

Design **No. 6:** Design of Journal Bearing

Design **No. 7:** Design of Spur/Helical Gear

Design **No. 8:** Design against fatigue loading for finite and infinite life

Design **No. 9:** Design of thin/ thick cylindrical shells under internal fluid pressure

Course Outcomes:

The students will be able to

CO1: Analyze life of components under fatigue loading.

CO2: Analyze operating conditions of Journal bearings, and use manufacturer's catalogue for selection of rolling contact bearings.

CO3: Identify, evaluate, compare and design different power transmission and absorption components like gears, clutches, and brakes.

CO4: Perform strength design of IC engine components.

CO5: Explain pressure vessels and their design.

DESIGN DATA HAND BOOKS:

1. "Design Hand Book", S. M. Jalaluddin; Anuradha Agencies Publications
2. "PSG Design Data Hand Book", PSG College of Tech Coimbatore
3. "Machine Design Data Book", K. Lingaiah, Tata McGraw Hill

TEXT BOOKS:

T19. "Mechanical Engineerng Design", J. E. Shigley, C. R. Mischke, R. G. Budynas and K.J. Nisbett, Tata McGraw-Hill , 8th Edition, 2008.

T20. "Design of Machine Elements", V. B. Bhandari, Tata McGraw-Hill, 3rd Edition, 2010.

T21. "A Text Book of Machine Design", R. S. Khurmi and J.K. Gupta, S. Chand Publication, 14th Edition, 2005.

REFERENCE BOOKS:

R37. "Design of Machine Elements", M.F. Spotts, T. E. Shoup and L.E. Hornberger, Pearson/Prentice Hall, 8th Edition, 2007.

R38. "Machine Design", P. C. Sharma and D. K. Agrawal, S.K.Kataria & Sons, 11th Edition, 2007.

R39. "Machine Design", R. L. Norton, Pearson Education Asia, 5th Edition, 2001.

R40. "Fundamental of Machine Component Design", R.C. Juvinall and K.M. Marshek, Wiley India Pvt. Ltd., New Delhi, 3rd Edition, 2007.

R41. "Machine Design", P. Kanaiah, Scietech Publications, 2nd Edition, 2008.

R42. "Machine Drawing", N. D. Bhatt and V. M. Panchal, Charotar Publishing House Pvt. Ltd, 49th Edition, 2014.

REF NO: To be filled by CD office

ME35367:: Numerical Computation Lab

Credits: 01 **Teaching Scheme: -** Laboratory 02 Hrs/Week

Pre & Co-requisites:

1. Computer Programming
2. Computational Methods in Mechanical Engineering

Course Objectives:

1. To develop computational skill using MATLAB as a programming language.
2. To find the root(s) of non-linear equations using Bisection/Newton-Rapshon/Secant methods.
3. To apply various numerical integration methods for calculating numerical values of definite integrals as well as solving ordinary & partial differential equations.
4. To find Eigen values and Eigen vectors of matrices using numerical method approach.
5. To solve simultaneous linear equations using Gauss Elimination/Gauss Siedel method.
6. To apply numerical differentiation method for estimating derivatives of mathematical functions using forward as well as backward difference approach.

Course Details:

List of Practical (*Any Ten*)

Experiment No. 1: Introduction to MATLAB; Basic Mathematical Operations: Arithmetic, Logarithmic, Exponential, Trigonometric & Inverse Trigonometric; Working with Complex Numbers, Numeric Functions, Display Format.

Experiment No. 2: Working with Arrays: Accessing, Adding & Deleting Elements; Built-in Functions; Mathematical Operations, Element-by-Element Operations, Arrays in Built-in Math Functions.

Experiment No. 3: Script Files: Creating, Saving & Executing, Input & Output; Function Files: Function Definition Line, Anonymous Functions.

Experiment No. 4: 2-Dimensional Plot: *plot* Command, Plot of a Function, Multiple Graphs in the Same Plot, *hold on* & *hold off* Command, Multiple Plots in the Same Page, Formatting a Plot.

Experiment No.5: Control Flow Statements & Loops: Relational & Logical Operations, Conditional Statements, *switch-case* Statements, *for-end* & *while-end* Loops, *break* & *continue* Commands.

Experiment No. 6: MATLAB Implementation (including graphics) of Bisection Method.

Experiment No. 7: MATLAB Implementation (including graphics) of Newton-Rapshon/Secant Method.

Experiment No. 8: MATLAB Implementation of Numerical Integration Method: The Trapezoidal Rule, The Simpson's 1/3 rd and $3/8^{th}$ Rules.

Experiment No. 9: MATLAB Implementation (including graphics) of Eigen Value Problems: Basic Power Method/Rayleigh Quotient Method/Shifted Power Method/Inverse Power Method/QR method (Any One).

Experiment No. 10: MATLAB Implementation of Gauss Elimination/Gauss-Siedel Method to Solve System of Linear Equations.

Experiment No. 11: MATLAB Implementation of Numerical Differentiation Method: Forward and Backward Difference Methods.

Experiment No. 12: MATLAB Implementation of Initial Value Problems: Taylor Series Method/Euler Method/ Modified Euler Method/Runge-Kutta Method (Any One).

Course Outcomes:

The students will be able to

CO1: develop computational skill using MATLAB as a programming language.

CO2: determine the root(s) of non-linear equations using Bisection/Newton-Rapshon/Secant methods.

CO3: apply various numerical integration methods for calculating numerical values of definite integrals as well as for solving ordinary & partial differential equations.

CO4: evaluate Eigen values and Eigen vectors of matrices using numerical method approach.

CO5: solve simultaneous linear equations using Gauss Elimination/Gauss Siedel method.

CO6: apply numerical differentiation method for estimating derivatives of mathematical functions using forward as well as backward difference approach.

Text Books:

T1. "MATLAB: An Introduction with Applications", Amos Gilat, John Wiley & Sons, Inc., Fourth Edition, 2011.

T2. "Applied Numerical Methods with MATLAB for Engineers and Scientists", S. C. Chapra, TMH, Third Edition, 2012.

T3. "Numerical Methods for Engineers and Scientists", J. D. Hoffman, Marcel Dekker Inc., Second Edition, 2001.

Reference Books:

R1. "Numerical Methods", E. Balagurusamy, TMH, 25th Reprint, 2008.

R2. "Getting Started with MATLAB", Rudra Pratap, Oxford University Press, First Edition, 2010.

R3. "MATLAB Programming for Engineers", S. J. Chapman, Thomson Learning, Fourth Edition, 2008.

REF NO: To be filled by CD office

IN37403:: Pre-placement Training

Credits: 01 **Teaching Scheme: -** Laboratory 02 Hrs/Week

REF NO: To be filled by CD office

ME31366:: Production & Dynamics Lab

Credits: 01 **Teaching Scheme: -** Laboratory 02 Hrs/Week

Pre & Co-requisites:

1. Dynamics of Machines
2. Production Metallurgy
3. Metal Cutting and Machine Tools
4. Design of Machine Components

Course Objectives:

The main objective of the course is build to a strong foundation and to acquaint the students with the

1. concepts of gyroscopic effect and calculation of gyroscopic couple.
2. performance of governor and procedure of mechanical balancing.
3. frictional characteristics in journal bearing.
4. operational practices on milling, shaping, planning and grinding machines.
5. measurement of cutting forces/torque using tool dynamometer
6. effect of heat treatment process on microstructure, and study of surface roughness.
7. part programming aspects in CNC machining.

Course Details:

List of Practical (*Any Ten*)

Experiment No. 1: Determination of gyroscopic couple on a spinning disc subjected to applied torque

Experiment No. 2: Determination of controlling force at a given speed, governor effort & power for a Hartnell governor

Experiment No. 3: Determination of coefficient of friction & frictional torque for a journal bearing

Experiment No. 4: Determination of balancing mass for complete balancing by drawing force and couple polygon

Experiment No. 5: Making a helical gear in a Milling Machine by Indexing.

Experiment No. 6: Reduction of work piece thickness using planner

Experiment No. 7: Determination of cutting forces/torque in turning/drilling using tool dynamometer.

Experiment No. 8: Making an external key way on the given work piece using Shaping Machine.

Experiment No. 9: Comparative study on microstructure of metal specimen with and without annealing process.

Experiment No. 10: Reduction of diameter of a cylindrical job by cylindrical grinding machine.

Experiment No. 11: Part programming for CNC machining.

Experiment No. 12: Measurement of surface roughness using surface roughness tester.

Course Outcomes:

Students will be able to

CO1: observe the gyroscopic effect and evaluate the gyroscopic couple.
CO2: evaluate the performance of governor and carry out balancing test.
CO3: evaluate frictional characteristics in journal bearing.
CO4: perform shaping, planning and grinding operations and carry out indexing operation on milling machine.
CO5: measure cutting forces/torque in turning/drilling operation using tool dynamometer.
CO6: demonstrate the effect of heat treatment process on microstructure, and measure surface roughness of a machined specimen.
CO7: perform part programming in CNC turning/milling.

Text Books:

T3. "Theory of Machines", S.S Rattan., Tata McGraw-Hill, 3rd Edition, 2009.

T4. "Machining Technology; Machine Tools and Operation", A.Youssef and H. El-Hofy, CRC Press., 3rd Edition, 2008.

Reference Books:

R4. "Mechanisms and Machine Theory", J.S. Rao.and R.V. Dukkipati., Wiley-Eastern Ltd., 2nd Edition, 2008.

R5. “Theory of Mechanisms and Machines", A. Ghosh and A.K., Mallick, East-West Pvt. Ltd., 3rd Edition, 2001

R6. “Elements of Workshop Technology-Vol II”, S.K. Hajra Choudhary and A.K.Hajra Choudhary, Media Publishers, Bombay, 2014.