B.Tech. Mechanical Engineering, Third Year [5th Semester]

Sr. No.	Course No.	Subject	L	T	P	Hours	Credits
1.	ME-310	Open Elective-I	3	0	0	3	3
2.	ME-311	Thermal Engineering	3	1	0	4	4
3.	ME-312	Machine Design-I	3	0	0	3	3
4.	ME-313	Measurement and Control	3	1	0	4	4
5.	ME-314	Dynamics of Machinery	3	1	0	4	4
6.	HS-301	Principles of Management	3	1	0	4	4
7.	ME-314 (P)	Design Lab-I	0	0	2	2	1
					Total =	24	23

Open Elective - I [ME-310]
   a) Industrial Robotics
   b) Finite Element Method
   c) Finite Volume Method
   d) Total Quality Management
   e) Friction and Wear

ME-311

THERMAL ENGINEERING

L T P/D Cr
3 1 0   4

1. **POWER CYCLES**: Vapor power cycles, Rankine cycle with reheat, regeneration, bleeding of steam, binary vapor cycles. Deviation of actual cycles from ideal cycles, internal and stage efficiencies, reheat factor, Ericsson cycle, Steam power Plant.

2. **BOILERS**: Types, water tubes and fire tube boilers, high pressure boilers, mounting and accessories, natural and forced circulation, Boiler draught, Boiler trial and heat balance, Fluidized bed boilers.

3. **COMPRESSOR**: Single and multistage reciprocating compressor, effect of intercooling, volumetric efficiency

4. **CONDENSER**: Jet and surface condenser, condenser vacuum and vacuum efficiency, Cooling towers, Air ejectors

5. **STEAM NOZZLES**: Steady flow energy equation and its application to steam nozzles, isentropic expansion of steam through convergent and divergent nozzles, critical pressure, condition for maximum discharge, choking of nozzles, effect of back pressure, super saturated flow through nozzles, flow with friction nozzle efficiency

6. **STEAM TURBINES**: Principle and working of impulse and reaction turbines, pressure and velocity compounding; velocity triangles for various types, efficiency, diagram efficiency, steam speed to blade speed ratio for optimum performance, losses in steam turbine, performance and governing of steam turbines

7. **GAS TURBINE PLANTS**: Brayton cycle, regeneration and reheating, open and closed cycle gas turbine plants.

BOOKS RECOMMENDED:

1. Thermal Engineering   P.L.Ballaney
2. Thermal Engineering   R.K.Rajput
3. Thermal Power Engineering   R.Yadav
4.Thermal Engineering   Domkundwar

ME-312   **MACHINE DESIGN-I**

                                                         L   T   P/D   Cr
                                                         3   0   0   3

1. **DESIGN PRINCIPLES**: Mechanical Engg. design, phases of Design, design considerations, factor of safety, stress concentration, methods of reducing stress concentration, Notch sensitivity, Types of loading, S.N curves Determination of fatigue strength, Soderberg's line for design, Goodman's line for design, Gerber's curves for design.

2. **DESIGN OF SHAFTS AND COUPLINGS**: Design of solid and hollow shafts, design of shafts for strength and deflection, combined loading due to torsion and bending of shafts, Principal stress and maximum stress, equivalent bending moment and twisting moment, design of Muff coupling, flange coupling, bushed pin type of flexible coupling

3. **DESIGN OF FASTENERS**: Pins, keys, splines, knuckle joint, cotter joint, design of threaded joints, initial tension, riveted joints, joints for pressure vessels, welded joints: types

4. **DESIGN OF LEVERS**: Introduction, Design procedure, weight reduction of levers, handles and paddles, hand levers and foot levers, cranked levers

5. **DESIGN OF SPRING**: Closed and open coiled springs, strength and stiffness, optimum design of helical springs, helical torsion springs, multileaf springs, and helical springs of non-circular wires.

6. **DESIGN OF ELEMENTS**: I.C Engine parts like cylinder, piston, connecting rod and crankshaft.

7. **CASE STUDY**

BOOKS RECOMMENDED:

1. Design of M/c Elements   V.B.Bhandari
2. Machine Design   Patel, Sikh. and Pandya
3. Machine Design   Pandya & Shah
4. Machine Design   Sharma & Aggarwal
5. Machine Design   Shigley
6. Machine Design   Kulkarni
7. Machine Design   Sadhu Singh
8. Machine Design   R.K.Jain

HAND BOOK:
1. Design Data Book PSG College of Technology Coimbatore. Use of this hand book permitted on the examination.

ME – 313

MEASUREMENT & CONTROL

	L	T	P/D	Cr
	3	1	0	4

General Background: Instrument Classification, Characteristics of Instruments-Static and dynamic, experimental error analysis, Systematic and selection of measuring instruments Reliability of instruments, Classification of Transducers.

Data Acquisition & Signal Conditioning: Analog Devices, Resistance Measurements Amplification, Analog filters, Digital Devices, Digital signals, Analog to digital, Amplifiers, Operational Amplifiers, Differentiating and integrating elements, Terminology and conversions, Data Transmission elements, Indicating, recording and display elements, Data acquisition Systems.

Measurement methods & applications: Motion measurement, Force measurement, torque measurement by various dynamometers, High &Low pressure measurement, temperature measurement by non-electrical and radiation methods, Flow measurements, Measurement of humidity & moisture, Biomedical measurements/Biometrics.

Control System: Block diagram of automatic control system, closed loop system, open loop system feedback control system, feed forward control servomotor mechanism, comparison of hydraulic, pneumatic, electronic control system, proportional control action, Stability of control systems, Applications of measurements and control for setup for boilers, air conditioners motor speed control.

Digital Transducers-Interface system and Standards: Computer automated measurements and controls (CAMAC) standards –IEEE 488 standard interface –Remote monitoring and control of boiler horses –D-DAC (Distributed Data acquisition and Control Systems) –Microprocessor based temperature control system-Introduction to Microcontrollers-Process control system –Pneumatic systems.

Text Books:

1. K.Ogata, Modern Control System Engineering, Pearson education
2. Measurement system Applications and Design, E.O Doeblin, TMH
3. Instrumentation, Measurement &analysis, B.C Nakra & K.K Chaudhary, TMH
4. Morris. A.S,Principles of Measurements and instrumentation Prentice Hall of India,

Reference Books:

1. Fundamentals of Temterature, Pressure, and Flow Measurements, R.P.Benedict, John-Wiley
2. Measurement and Control Basics 2nd Ed.,T.A hughes,
3. Instrumentation for process Measurement and control, N.A Anderson,
4. George C Barney, Intelligent Instrumentation Microprocessor and Applications in Measurements and control, Prentice Hall, New Delhi,

ME-314
DYNAMICS OF MACHINERY

	L	T	P/D	Cr
	3	1	0	4

1. **INERTIA FORCE ANALYSIS**: D-Alembert's Principle, dynamic analysis of slider-crank mechanism, velocity & acceleration of piston, piston effect, crank effort, inertia of connecting rod

2. **TURNING MOMENT AND FLYWHEEL**: Inertia force calculations of turning moment in reciprocating engines, co-efficient of fluctuation of energy, co-efficient of fluctuation of speed, flywheels for punch press and I. C. engines

3. **BALANCING OF MACHINERY**: Necessity of balancing, balancing of rotating masses in one plane, in different planes, static and dynamic balancing, balancing of reciprocating masses, partial primary balance, condition of balance in multi cylinder in-line engines, balancing of V-engine, direct & reverse crank method of balancing

4. **GOVERNORS**: Functions, Difference between Governor and Flywheel, Types of Governors-Watt, Porter, Proell & Hartnell; Inertia Governors, Sensitiveness and Stability of Governors, Isochronous Governors, Hunting, Effort and Power of a Porter Governor, Controlling Force Diagrams For Porter and Spring Controlled Governors, Coefficient of Insensitiveness

5. **GYROSCOPIC COUPLE**: Gyroscopic couples, gyroscopic stabilization, gyroscope couple of a plane disc, gyroscopic effect on movement of a naval ship, ship stabilization, stability of automobile taking turn

6. **CAMS**: Cam mechanism and its uses, types of cams and followers, main considerations affecting choice of cam profile, SHM for follower, uniformly accelerated and decelerated motions, parabolic motion, uniform velocity motion for the follower, profile of cam operating an oscillating roller follower, profile of cam operating a flat faced follower.

BOOKS RECOMMENDED:

1. Theory of Machines   S. Rattan (TB)
2. Theory of Machines   Ballaney (TB)
3. Theory of Machines & Mechanisms   Rao & Dukkipati (TB)
4. Theory of Machines   Jagdish Lal (RB)
5. Theory of Machine   V.P.Singh
6. Vibration   S.S.Rao

ME – 310 (a)   **INDUSTRIAL ROBOTICS**

	L	T	P/D	Cr
	3	0	0	3

1. **FUNDAMENTAL OF ROBOTICS**: Introduction, automation and robotics, history of robotics, Advantages and disadvantages, investment on robot, economic analysis of robot, social impact, management and robotics, characteristics and application of the present robot, Application of robotics in industries.

2. **THE STRUCTURE OF ROBOTIC SYSTEM**: Anatomy of robot, classification of robot, robot configurations, robotic systems, robot specifications, performance parameters, robot drive systems, wrist and motions, Robot end effectors, force analysis of gripper mechanisms, Gripper design considerations, selection consideration of grippers, robot control system and components.

3. **ROBOT MOTION ANALYSIS**: Introduction to manipulator kinematics, Homogeneous transformation and robot kinematics, Manipulator parameters, The D-H representation, Kinematics arm equations, inverse kinematics problems, Robot arm dynamics, dynamics equations, Trajectory planning.

4. **ROBOT SENSORS AND VISION**: Introduction, classification of sensors and their functions, Position, velocity, acceleration sensors, proximity and range sensors, Touch and slip sensors, force and Torque sensors, Vision: Introduction to machine vision, Image processing and analysis, Robotic applications.

5. **ROBOT PROGRAMMING**: Introduction, methods of programming, Motion interpolations, Robot programming languages, Language structure, Programming languages-features and applications, Introduction to artificial Intelligence and robotics.

6. **ENGINEERING APPLICATIONS FOR MANUFACUTRING**: Robot cell design and control, Robot as peripheral device, Material transfer, machine loading and unloading, processing operations applications, Assembly and applications.

7. **IMPLEMENTATION PRINCIPLES, SOCIAL ISSUES AND FUTURE OF ROBOTICS**: Plant survey to identify potential applications, planning and engineering. The installation, safety, training and maintenance issues, social and labor issues, robotic technology of the future and future applications.

BOOKS RECOMMENDED:
1. Robotic Engineering - An Integrated Approach   Richard, Thomas, Chemielewski & Negin
2. Industrial Robotics   Gordon M. Mair
3. Introduction to Robotics   Craig
4. Introduction to Robotics- Analyis, Systems Application   Nikku
5. Robotics & Automated Manufacturing   Richard C.Dort
6. Industrial Robotics   Mikel, Groover, Nicholas, Odery
7. Fundamentals of Robotics   Robert J. Schilling

ME – 310 (b)   **FINITE ELEMENT METHODS**

L   T   P   Cr

3   0   0   3

1. **FUNDAMENTAL CONCEPTS**: Introduction, Historical background, stresses and equilibrium, boundary conditions, strain-displacement relations, stress-strain relations, temperature effects, Rayleigh-Ritz Method, Galerkin's Method, Saint Venant's Principle, Matrix algebra, Gaussian Elimination.

2. **FINITE ELEMENT MESHES**: Choice of mesh, mesh data in numerical form, generation of mexh data, mesh modification.

3. **ONE -DIMENSIONAL PROBLEMS**: Introduction, Finite element Modeling, Co-ordinates and Shape Functions, Potential energy approach, The Galerkin Approach, Assembly of Global stiffness matrix and load vector, Finite element equations; Treatment of boundary conditions, quadratic shape functions, Temperature effects.

4. **TRUSSES**: Introduction, plane trusses, three dimensional trusses, assembly of global stiffness matrix for the banded and skyline solution.

5. **TWO- DIMENSIONAL PROBLEMS**: Introduction, finite element modeling, constant strain triangle (CST), Problem modeling and boundary conditions.

6. **AXISYMMETRIC SOLIDS SUBJECTED TO AXISYMMETRIC LOADING**: Introduction, Axisymmetric formulation, finite element modeling: Triangular elements, Problem modeling and boundary conditions.

7. **TWO -DIMENSIONAL ISOPARAMETRIC ELEMENTS AND NUMERICAL INTEGRATION**: Introduction, The fournode quadrilateral, Numerical Integration, Higher order element, Problem related to beams.

8. **BEAMS AND FRAMES**: Introduction, finite element formulation, load vector, boundary considerations, shear force and bending moment beams on elastic supports, plane frames, three dimensional frames.

9. **FINITE ELEMENT METHODS IN FLUID FLOW &. HEAT TRANSFER**: 1-D Steady heat conduction, 1-D heat conduction in thin fins, 2-D Steady heat conduction, 2-D Fins. 1-D & 2-D heat disfusion, incompressible inviscid flow (potential flow), acoustic flow, and viscous incompressible fluid flow.

RECOMMENDED BOOKS:

1.	Introduction to Finite Elements in Engineering	Tirupathi, Chandrupatle, Belegundu
2.	An Introduction to Finite Element Method	J.N. Reddy
3.	Finite Element Analysis -Theory and Programming	C.S. Krishnamurthy
4.	The Finite Element Method in Engineering	S.S. Rao
5.	Finite Element Methods for Engineers	Roger T.Fennee
6.	Finite Element Analysis in Engg. Design	Rajoebaron

ME – 310 (c)   **FINITE VOLUME METHOD**

L   T   P   Cr

3   0   0   3

1. **DISCRETIZATION METHODS**: Review of other methods, control volume formulations, four basic rules.

2. **HEAT CONDUCTION**: Steady one- dimensional conduction: grid spacing, interface conductivity, non-linearity, source term linearization, boundary conditions, unsteady state one dimensional conduction; explicit, implicit and crank Nicolson scheme, two and three-dimensional conduction, over and under relaxation.

3. **CONVECTION AND DIFFUSION**: Steady one- dimensional convection and diffusion, upwind scheme a generalized formulation, discretization equation for two dimensions.

4. **FLOW FIELD**: Continuity and momentum equation, pressure correction equations, simple algorithms.

5. **APPLICATIONS**: Developing flow in curved pipe, two-dimensional heat conduction on a non-uniform mesh, heat conduction in cylindrical geometry, an symmetric steady conduction in spherical coordinators.

BOOKS RECOMMENDED:

1. Numerical Methods in Heat Transfer & Fluid Flow   S.V.Patankar

2. Computational Fluid Flow and Heat Transfer   Muralidhar & G. Biswas

3. Computational Fluid Dynamics Vol.1 & 2   Fletcher

4. Computational Fluid Dynamics   Date, A. N.

ME – 310 (d)   **TOTAL QUALITY MANAGEMENT**

	L	T	P	Cr
	3	0	0	3

1. **QUALITY MANAGEMENT**: Evolution of Philosophy of Quality, Quality Gurus- Crosby, Deming and Juran, Attributes of Quality, Quality Characteristics-Quality of Design, Quality of Performance and Quality of Conformance, Organization For Quality, Total Quality Management (TQM), TQM Models, 4 – C'S of TQM; Barriers to Implement TQM.

2. **ORGANISING FOR QUALITY**: Developing an Organization Al Structure for Quality. Quality Management System. Role of top Management ,Quality Council, Quality Policies ,Quality Improvement Teams, Role of Middle and Lower Management ,Quality Circles, Organization Structure for Quality Circles. Problem Solving Techniques .Zero Defects.

3. **QUALITY MEASUREMENT; TOOL AND TECHNIQUES**: Seven Basic (B7)Tools – Cause & Effect Diagram, Flow Diagrams, Trend Charts, Histogram, scatter Diagram, Control Chart, New Seven (S7)Tools – Affinity Diagram, Inter relationship Diagram, Tree Diagram, Matrix Diagram, Process decision Program chart (PDPC) and Matrix Data Analysis.

4. **QUALITY ASSURANCE & CONTROL**: Causes of Quality Failure ,Quality Assurance-Need and Various Elements In Quality Assurance Programme. Quality Control- On Line and Off Line, Statistical Concepts in Quality, Chance and Assignable causes. Types of control charts. Control chart for variables (X and R charts).Interpreting patterns of variations on X and R charts. Control chart for attributes: Attribute chart for defectives, P- chart, NP- chart. Attribute chart for number of defects per unit ,C-Chart and U-Chart.

5. **INNOVATIVE TECHNIQUES IN QM**: Quality Function Deployment (QFD)- Definition and Phases in QFD , Taguchi Approach to quality-system design, parameter design and Tolerance design, Six- Sigma -Definition & Implementation Steps, ISO-9000 and 14000, Role of Total Productive Management (TPM), Bench Making in quality management.

6. **QUALITY SYSTEMS**: Seven QC tools of quality control, Histogram, Scatter diagram, Standardisation

RECOMMENDED BOOKS:

1. TQM Text with Cases   Amrik Sohal
2. Managing Quality   B. G. Pale
3. TQM Text with Cases   John S. Oaklend
4. TQM and ISO –14000   Arora
5. TQM   Besterfield

ME- 310(e)   **FRICTION AND WEAR**

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L T P C

3 0   0   3

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1. **FUNDAMENTALS**: Surface Topography and contacts, Measurement of surface topography, Surface roughness and its quantification, Topography of surfaces, Contact between surfaces

2. **FRICTION**: Definition, Sliding Friction: Quantitative Laws of sliding friction, magnitude of the friction force, criticism of the adhesive theory, other contributions to the friction force, rolling force, sliding friction, Models of asperity deformation, friction of metals ceramics and Polymers.

3. **ROLLING FRICTION**: Laws of rolling friction, measurement of friction.

4. **TYPES OF WEAR**: Types of wear and its measurement. Mechanisms of Adhesive, Abrasive, Corrosive, and Fatigue wear, Laws associated with different wear mechanisms

5. **MECHANISMS FOR MITIGATING FRICTION AND WEAR**.

BOOKS RECOMMENDED:

1. Friction and Wear of Materials by Rabinowicz

2. Fundamentals of Tribology by Basu, Sengupta, Ahuja

3. Fundamentals of Fluid Film Lubrication by Hamrock, Schmid, Jacobson

4. Applied Tribology Bearing Design and Lubrication by Khonsari and Booser

5. Principles and Applications of Tribology by Bhushan B.

6. Engineering Tribology by Williams

7. Tribology: Friction, Lubrication & Wear by Szeri