SEMESTER-IV

Sl No.	Course Code	Course Title	Hours Per Week			Total Credits	ESE	IA
			Lecture	Tutorial	Practical			
1.	102401	Applied Thermodynamics	3	1	0	4	70	30
2.	102402	Fluid Mechanics and Hydraulic Machines	3	1	0	4	70	30
3.	102403	Strength of Material	3	1	0	4	70	30
4.	102404	Kinematics of Machine	3	0	0	3	70	30
5.	102405	Project Management	3	0	0	3	70	30
6.	102402P	Fluid Mechanics and Hydraulic Machines Lab	0	0	2	1	30	20
7.	102403P	Strength of Material Lab	0	0	2	1	30	20
8.	102404P	Kinematics of Machine Lab	0	0	2	1	30	20
9.	102406	NPTEL-I (Open course)	12 Weeks			3	75	25
TOTAL						24	750	

SEMESTER-IV

Course Code-102401 Applied Thermodynamics 3 1 0 4

Unit- 1.0 **7 hrs**

Introduction to solid, liquid and gaseous fuels–Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature Chemical equilibrium and equilibrium composition calculations using free energy.

Unit- 2.0 **8 hrs**

Thermodynamic cycles: Air standard Otto, Diesel and Dual Cycles, Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles-.
Vapor power cycles Rankine cycle with superheat, reheat and regeneration, exergy analysis. Supercritical and ultra-super-critical Rankine cycle- Gas power cycles,

Unit- 3.0 **6 hrs**

Refrigeration System: Simple Vapor compression refrigeration cycle and Vapor Absorption Cycle, refrigerants and their properties.

Unit- 4.0 **7 hrs**

Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.

Unit- 5.0 **6 hrs**

Analysis of steam turbines, velocity and pressure compounding of steam turbines.

Unit- 6.0 **8 hrs**

Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows- normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam and refrigerant through nozzle, super saturation compressible flow in diffusers, efficiency of nozzle and diffuser.

Text/Reference:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, Fundamentals of Thermodynamics, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, Engineering Thermodynamics, Prentice-Hall of India.
3. Moran, M. J. and Shapiro, H. N., 1999, Fundamentals of Engineering Thermodynamics, John Wiley and Sons.
4. Nag, P.K, 1995, Engineering Thermodynamics, Tata McGraw-Hill Publishing Co. Ltd.

Course Code-102402 Fluid Mechanics & Hydraulic Machines 3 1 0 4

Unit- 1.0: 5 hrs

Properties of Fluid: Definition of fluid; Newton's law of viscosity; Units and dimensions; Physical properties of fluids; Control volume; Continuity equation and momentum equation; Incompressible flow; Bernoulli's equation and its applications.

Unit- 2.0: 7 hrs

Dimensional Analysis: Dimensionally homogeneous equations; Buckingham Pi Theorem; Calculation of dimensionless parameters. Similitude and complete similarity; Model scales; Basic boundary layer theory and analysis.

Unit- 3.0: 6 hrs

Fluid Kinematics: Different approaches; Reynolds transport theorem; Flow visualization; Types of flow; Strain rate, stream line, streak line, path lines and stream tubes; Continuity equation in Cartesian coordinates in 3D forms; Velocity and acceleration of fluid particles; Velocity potential function and stream function.

Unit- 4.0: 6 hrs

Momentum Equation: Momentum equation; Nervier Stoke equation; Development of Euler's equation; Bernoulli's equation and application; Steady and unsteady flow through orifice; Orifice placed in pipe; Venturimeter; Flow over triangular and rectangular notches; Pitot tube.

Unit- 5.0: 8 hrs

Laminar and Turbulent Flow: Viscous/Laminar flow – Plane Poiseuille flow and Coutte flow; Laminar flow through circular pipes; Loss of head and power absorbed in viscous flow; Turbulent flow – Reynolds experiment; Frictional losses in pipe flow; Shear stress in turbulent flow; Major and minor losses (Darcy's and Chezy's equation); Flow through siphon pipes; Branching pipes and equivalent pipe.

Unit- 6.0: 10 hrs

Rotodynamic Machines: Euler's equation; Theory of Rotodynamic machines; Various efficiencies; Velocity components at entry and exit of the rotor; Velocity triangles; Centrifugal pumps – working principle, work done by the impeller and performance curves; Cavitation in pumps; Reciprocating pump – working principle.

Hydraulic Turbines: Classification of water turbines; Heads and efficiencies; Velocity triangles; Axial, radial and mixed flow turbines; Pelton wheel, Francis turbine and Kaplan turbines – working and design principles.

Text/Reference:

1. S.S. Rattan, Fluid Mechanics & Hydraulic Machines, Khanna Book Publishing, 2019.
2. P.J. Pritchard, A.T. McDonald and R.W. Fox, "Introduction to Fluid Mechanics," Wiley India, 2012.
3. F.M. White, "Fluid Mechanics," Tata McGraw Hill, 2011.
4. S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill, 2017.
5. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines," Laxmi Publication, 2005. 6. Mechanics of Fluids, Shames, McGraw Hill Book Co., New Delhi, 1988.

Course Code-102403 Strength of Materials 3 1 0 4

Unit- 1.0 **7 hrs**

Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle, theories of failure,

Unit- 2.0 **6 hrs**

Beams and types transverse loading on beams- shear force and bend moment diagrams- Types of beam supports, simply supported and over-hanging beams, cantilevers.

Unit- 3.0 **6 hrs**

Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.

Unit- 3.0 **8 hrs**

Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorems.

Unit- 4.0 **7 hrs**

Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at both ends, stresses and deflection of helical springs.

Unit- 5.0 **8 hrs**

Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure.

Text /Reference:

1. Egor P.Popov, Engineering Mechanics of Solids, Prentice Hall of India,NewDelhi,2001.
2. R.Subramanian, Strength of Materials, Oxford UniversityPress,2007.
3. Ferdinand P.Been, Russel Johnson Jr. and John J.Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi2005.

Course Code-102404 Kinematics of Machine 3 0 0 3

Unit- 1.0: **7 hrs**

Mechanisms

Definition and types of joints; Lower and higher pairs; Classification of mechanisms based on function and constraints; Common mechanisms such as slider crank and 4-bar mechanisms and their inversions; Quick return mechanism, Straight line generators, rocker mechanisms, universal joints, steering mechanisms, etc.

Basic Kinematic Concepts and Definitions

Degree of freedom and Grübler's formula; Grashof's rule and rotatability limits; Mechanical advantage.

Unit- 2.0: **6 hrs**

Geometric Design of Mechanisms

Kinematic Analysis of Simple Mechanisms Displacement, velocity, and acceleration analysis; Velocity analysis using instantaneous centers; Position, velocity and acceleration analysis using loop closure equations; Coincident points; Coriolis component of acceleration.

Unit- 3.0: **8 hrs**

Belt, Rope and Chain drives: Types of belt drives, Velocity ratio, Slip, Creep, Length of belt, Power transmitted, Ratio of tensions, Angle of contact, Centrifugal tension, Maximum tension, Initial tension, V belt drive, Ratio of Tensions in V belt and Rope drives, Kinematics of chain drive, Classifications of chains, Chain length.

Brakes – Types of brakes, Block brake, Band brake, Band and Block brake, Internal expanding brake,Condition of self-locking, Power transmitted and Heat generated

Unit- 4.0: **9 hrs**

Gears

Gear terminology, Involute and Cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting.

Gear Train: Analysis of simple, compound, reverted and epicyclic gear train with problems.

Unit- 5.0: **6 hrs**

Balancing of rotating masses: Balancing of rotating masses in the same plane by a single revolving mass. Balancing of several rotating masses in the same plane. Balancing of several rotating masses in different planes by two revolving masses in suitable planes.

Unit- 6.0: **6 hr**

Governors: Watt, Porter, Proel & Hartnell Governors, Effect of friction, controlling force, governor effort and power, sensitivity and isochronisms.

Text /Reference:

1. Thomas Bevan, "Theory of Machines," CBS Publishers & Distributors, 2005.
2. W. L. Cleghorn, "Mechanisms of Machines," Oxford University Press, 2005.
3. R. L. Norton, "Kinematics and Dynamics of Machinery," Tata McGraw Hill, 2009.
4. A. Ghosh and A.K. Mallick, "Theory of Mechanisms and Machines," Affiliated East-West Pvt. Ltd, New Delhi, 1988.

Course Code-102405 Project Management 3 0 0 3

Unit- 1.0 **7 hrs**

Basics of project Management: concept- Project Environment – Types of Projects- Project life Cycle project proposals – Monitoring project program.

Unit- 2.0 **7 hrs**

Project appraisal and project selection- Identification of investment opportunities- Source of new project ideas, preliminary screening of projects Feasibility studies and reports.

Unit- 3.0 **7 hrs**

Market feasibility: Market survey – categories of Market survey – steps involved in conducting arket survey – Demand forecasting techniques' sales projections.'

Unit- 4.0 **7 hrs**

Technical feasibility: Production technology, materials and inputs, plant capacity, site selection, plant layout, site preparation, Managerial Feasibility Project organization and responsibilities. Development of program evaluation & Review Technique (PERT)- Benefits of PERT.

Unit- 5.0 **7 hrs**

Financial Analysis: capital Expenditure – criteria and Investment strategies – capital Investment Appraisal Techniques (Non DCF and DCF) – Risk analysis – Cost of project and means of financing Estimation of cash flows – Estimation of Capital costs and operating costs; Forecasting income Preparation of detailed financial projections Breakeven point'

Unit- 6.0 **7 hrs**

project Management: Project implementation and review – project planning – project control – human aspects of project management – prerequisites for successful project implementation – project review'

Text /Reference:

1. Gido: Effective Project Management, 2e, Thomson,2007 ' .
2. Prasanna odelin, "Projects, Planning, Analysis, Selection, Financing' Implernentation and Review", TataMcGraw Hill Company Pvt. Ltd', New Delhi 1998' .
3. Damodaran, "Corporate Finance", Johy Wiley Publications'.
4. Erhardt & Brigham, "Principles of Corporate Finance", Thomson' 2006.'
5. Singh M.K, "Project Evaluation and Management" .
6. Prasad l.l.K, ,'Principles and Practice of Cost accounting", B. Pahwa, IIPS, Ploject Irinancing.'
7. Clifi"orci F. Gray, Erik Vr'. Larson, "Project Management, the Malragerial [mphasis", McCraw Iiill' 2000'.

Course Code- 102402P Fluid Mechanics & Hydraulic Machines 0 0 2 1

Perform any ten experiments

List of Experiments:

1. Determination of density & viscosity of oil.
2. To determine the meta-centric height of a floating body.
3. Measurement of Coefficient of Discharge of given Orifice and Venturimeter
4. To determine the coefficient of discharge of Notch (V and Rectangular types)
5. To determine the friction factor for the pipes.
6. To verify the Bernoulli's Theorem.
7. To find critical Reynolds number for a pipe flow.
8. To determine the minor losses due to sudden enlargement, sudden contraction and bends.
9. To show the velocity and pressure variation with radius in a free and forced vortex.
10. Performance on hydraulic turbines:
    a. Pelton wheel
    b. Francis turbine
    c. Kaplan turbine.
11. Performance on hydraulic pumps:
    a. Single stage and multi stage centrifugal pumps.
    b. Reciprocating pump.
    c. Performance test of a two stage reciprocating air compressor.
    d. Performance test on an air blower.

Course Code- 102403P **Strength of Materials Lab** **0 0 2 1**

Perform any ten experiments

List of Experiments:

1. Hooke's Law.
2. Hardness Test: Rockwell, Brinell, Vicker.
3. Izod & Charpy Impact Test.
4. Bending Test.
5. Torsion Test.
6. Shear test.
7. Compressive strength test.
8. Fatigue Test.
9. Verification of Maxwell's reciprocal theorem.
10. Continuous beam deflection test.
11. Strain Measurement.

Course Code- 102404P **Kinematics Machine Lab** **0 0 2 1**

Perform all experiments

List of Experiments:

1. To study various types of Links, Pairs, Chain and Mechanism.
2. To study inversion of Four Bar Mechanism.
3. To plot slider displacement, velocity and acceleration against crank rotation for single slider crank mechanism.
4. To find coefficient of friction between belt and pulley.
5. To generate spur gear involutes tooth profile using simulated gear shaping process.
6. To study various types of gears- Helical, cross helical worm and bevel gear.
7. Estimation of Velocity ratios of simple, compound, epicyclic and differential gear trains
8. To fabricate the innovative models based on inversions, Gear trains, etc.
9. To perform the experiment of Balancing of rotating parts and find the unbalanced couple and forces.
10. To Perform Experiment on Watt, Porter, Proell and Hartnell Governors and prepare Performance Characteristic Curves also analyze Stability & Sensitivity

B.Tech (Mechanical Engineering) **(SESSION 2024 Onwards)**

Course Code- 102406 **NPTEL-I (Open Course)** **12 Weeks (3 Credits)**

NPTEL (Open Course) Guidelines:

NPTEL (Open Course) should be taken from the course other than core subjects of the branch