Jharkhand University of Technology, Ranchi
B.Tech. (Mechanical Engineering)

Semester-III

S.No.	Course Code	Course Title	Hours per week				Cr	FM	Overall Pass Marks	Internal (CIE)	External (SEE)		Categorization
			L	T	P	J					FM	PM	
01	BSC301	Transformation Techniques and Complex Variable	3	1	0		4	100	35	30	70	21	BSC
02	MEC302	Engineering Thermodynamics	3	0	0		3	100	35	30	70	21	MEC
03	MEC303	Fluid Mechanics	3	0	0		3	100	35	30	70	21	MEC
04	MEC304	Mechanics of Solids	3	0	0		3	100	35	30	70	21	MEC
05	MEC305	Manufacturing Process-I	3	0	0		3	100	35	30	70	21	MEC
Total			**15**	**1**	**0**		**16**	**500**	--	--	--		--
Practical			**L**	**T**	**P**		**Cr**	**FM**	**Overall Pass Marks**	**Internal**	**External**		**Categorization**
											FM	**PM**	
06	MEC303P	Fluid Mechanics Lab	0	0	2		1	50	25	30	20	10	MEC
07	MEC304P	Material Testing Lab	0	0	2		1	50	25	30	20	10	MEC
08	MEC306P	Machine Drawing AutoCAD	0	0	4	6	2	50	25	30	20	10	MEC
Total			**0**	**0**	**8**		**4**	**150**	--	--	--		--
Audit Course			**L**	**T**	**P**		**Cr**	**FM**	**Overall Pass Marks**	**Internal**	**External**		**Categorization**
											FM	**PM**	
09	AUC301	Professional Skills	3	0	0		--	100	35	30	70	21	AUC
10	AUC302P	Sports/NCC/NSS/YOGA/Painting/Music/ Classical Dance	6				Student shall participate actively in one of the activities and for Passing of the semester "Participation Certificate" in activity will be mandatory. Student participation shall be monitored and participation record shall be maintained at institute level.						
Total			**3**	**0**	**0**		--	**100**	--	--	--		--
Grand Total			**18**	**1**	**8**	**6**	**20**	**750**	--	--	--		--

***BSC: Basic Science, MEC- Mechanical, AUC- Audit Course; L: Lecture, T: Tutorial, P: Practice.**

J- Self learning hours shall not be reflected in the Time table. Self-learning includes micro project/ assignment/ other activities as mentioned in earlier semester.

Jharkhand University of Technology
Ranchi, 834010

SCHEME OF INSTRUCTION AND SYLLABUS

For B.Tech. Program in

Mechanical Engineering

(Effective from 2024-25)

DEPARTMENT OF MECHANICAL ENGINEERING

(3rd – SEMESTER)

Transformation Techniques and Complex Variable

BSC301

Course Outcomes:

At the end of the course, the student shall be able to:

CO1	Introduce the application of Laplace Transform and solution of engineering problems in the form of differential equations.
CO2	Develop the understanding of transform the signal from time domain into frequency domain using Fourier Transform
CO3	Introduce z-transform and its application in the solution of difference Equation
CO4	Analyze engineering problems of fluid mechanics, Thermodynamics and electric field involving complex functions.
CO5	Understand the conceptual knowledge of integration over contour having complex variables.

Syllabus Unit Wise, Teaching Hours

Unit 1 **(10 hours)**

Laplace Transform

Laplace Transform and Its Properties, Transform of Derivatives, Transform of Integrals, Inverse Laplace transform, Convolution Theorem, Unit Step Function, Unit Impulse Function, Solution of ODE by Laplace Transform.

Unit 2 **(7 hours)**

Fourier transform

Fourier Integrals, Fourier Transform and Properties, Fourier Sine Transform, Fourier Cosine Transform, Inverse Fourier Transform, Inverse Fourier Sine and Cosine Transform.

Unit 3 **(8 hours)**

Z- Transform

Z-transform, Properties of Z-Transform, Initial and Final value Theorem, Convolution Theorem, Inverse Z-Transform, Solution of Difference Equation using Z-transform.

Unit 4 **(9 hours)**

Complex Variable: Differentiation

Derivative of Complex Functions, Analytic Function, Cauchy-Riemann Equation, C-R Equation in Polar form, Harmonic Function, Milne-Thomson's Method, Harmonic Conjugate, Conformal Mapping, Bilinear Mapping, Mobius Tranformation and their Properties.

Unit 5 **(8 hours)**

Complex Variable: Integration

Contour Integral, Cauchy's Integral Theorem, Cauchy's Integral Formula, Taylor's Series, Laurent's Series, Zeros and singularity of Analytic Function, Poles and Residues, Cauchy's Residue Theorem and Evaluation of Integrals.

Materials and access:

Textbooks:

1. Advanced Engineering Mathematics (10th edition) by Erwin Kreyszig, Wiley Eastern Ltd.

2. The Laplace Transform: Theory and Application, Joel L. Schiff.

3. N.P. Bali And Manish Goyal, A Text Book Of Engineering Mathematics, Laxmi Publications, Reprint, 2008.

Reference Books:

1. J. W. Brown And R. V. Churchill, Complex Variables And Applications, 7th Edition, Mc- Graw Hill, 2004.

2.M. J. Ablowitz and A. S. Fokas, Complex Variables- Introduction and Applications, Cambridge University Press, 1998 (Indian Edition).

3. G.B. Thomas and R. L. Finney, Calculus and Analytic Geometry, 9th Edition, Pearson, Reprint, 2002.

4. B. S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 42nd Edition.

ENGINEERING THERMODYNAMICS

MEC302

Course Outcomes:

At the end of the course, the student shall be able to:

CO1	Apply relevant thermodynamic relations based on the type of working fluid.
CO2	Evaluate thermodynamic properties and moving boundary work based on the type of process.
CO3	Apply the first law of thermodynamics to closed and open systems to arrive solutions.
CO4	Check the feasibility of a thermodynamic system and evaluate its performance by applying the second law of thermodynamics.
CO5	Apply entropy and exergy balance to closed and open systems for the performance evaluation.
CO6	Express the derived properties in terms of measurable properties.

Course Articulation Matrix:

	Program Outcomes [POs]												Program Specific Outcomes [PSOs]*			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	1		1								1			
CO2	3	3	1										1			
CO3	3	3	3			1	1						1			
CO4	3	3	3		1								1			
CO5	3	3	3		1								1			
CO6	3	3	1										1			

Course Objectives

The course will enable the students to

- Educate the properties of ideal gases, real gases, and pure substances.
- Elucidate basic concepts and thermodynamic properties.
- Familiarize with various laws of thermodynamics.

• Instruct the method of applying energy, entropy, and exergy balance to systems. • Distinguish the measurable and non-measurable properties.

Syllabus

Unit 1

Properties of working fluids: ideal gas behavior, real gas behavior, equation of state, compressibility factor, compressibility chart, properties of pure substance. Basic concepts and Thermodynamic properties: system, surroundings, boundary, properties, state and equilibrium, process, cycle, temperature, pressure and specific volume, heat and work, internal energy and enthalpy. **[12 hours]**

Unit 2

Laws of Thermodynamics:

Zeroth law: thermal equilibrium, temperature measurement in various scale, First law: static and dynamic form of energy, law of conservation of energy, energy balance to closed and open systems – steady and unsteady flow devices and limitations of the first law of thermodynamics [**6 hours**]

Unit 3

Second law: Kelvin-Planck and Clausius statements, Carnot theorem, Clausius inequality, the concept of entropy, principle of increase of entropy, Third law: absolute entropy **[6 hours]**

Unit 4

Entropy and Exergy Balance: Irreversibility's change in entropy, entropy transfer by heat and mass, entropy generation, entropy balance applied to closed and open systems. Available and unavailable energy, exergy destruction, second law or exergetic efficiency, exergy transfer by heat, work and mass, exergy balance applied to closed and open systems. **[10 hours]**

Unit 5

Thermodynamic property relations: Maxwell relations, Clausius-Clapeyron equation, change in internal energy, change in enthalpy, change in entropy relations, Joule Thomson coefficient and inversion line. **[8 hours]**

Textbooks:

1. Cengel Y. A. and Boles M. A., "Thermodynamics – an Engineering Approach", 8/e, Tata McGraw hill, 2016

Reference Books:

1. Sonntag R. E., Borgnakke C. and Van Wylen, G., "Fundamentals of Thermodynamics", , John Wiley and Sons, 2008
2. Pramod Kumar and Atul Dhar., "Basics of Thermodynamics", 1/e, AICTE, 2023
3. Michael J. Moran and Howard N. Shapiro., "Fundamentals of Engineering Thermodynamics", 9/e, John Wiley and Sons, Inc., 2018

Fluid Mechanics

MEC303

Course Outcomes:

At the end of the course, the student shall be able to:

CO1	Apply conservation laws to fluid flow problems in engineering applications
CO2	Design experimental procedure for physical model studies.
CO3	Use of different fluid flow measuring devices.
CO4	Compute drag and lift coefficients using the theory of boundary layer flows.
CO5	Analyze and design pipe flows.

Course Articulation Matrix:

	Program Outcomes [POs]												Program Specific Outcomes [PSOs]*			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	3	2	2					1	1		2	2	1		
CO 2	3	3	3	3					1	1		2	2	1		
CO 3	2	1	3	1	1				1	1		1	2	1		
CO 4	2	1	3	2				1	1	1		1	2	1		
CO 5	3	2	3	2	1				1	1		1	2	1		

1 - Slightly; 2 - Moderately; 3 – Substantially

Unit 1

Introduction: Importance of fluid mechanics and its application to various engineering areas, fluid and its classification: ideal, real, Newtonian, non-Newtonian fluids, characteristic properties of fluids. Surface Tension, Capillary, Compressibility, Bulk modulus, fluid viscosity, density, vapor pressure, cavitation. **[08 Hours]**

Unit 2

Statics: Pressure at a Point, Standard Atmosphere, Measurement of Pressure: Manometry, Mechanical and Electronic Pressure-Measuring Devices, Hydrostatic Force on a Plane and Curved Surface, Buoyancy, Flotation, and Stability. **[08 Hours]**

Unit 3

Description of fluid flow: with reference to translation, rotation and deformation concept of continuum, control mass & control volume approach, Reynolds transport theorem. Steady flow and uniform flow.

Velocity field, one & two-dimensional flow analysis, circulation and vorticity, stream function and velocity potential function, potential flow, standard flow patterns, combination of flow patterns, flow net. Continuity equation, Euler's equation of motion, Bernoulli's equation and its applications in flow measurement, Impulse momentum equation and applications. **[10 Hours]**

Unit 4

Dimensional Analysis as a tool in design of experiments, identification of non-dimensional numbers and their significance, dimensional analysis methods.

Equations of motion for laminar flow of a Newtonian fluid - Viscous flow - Navier-Stoke's equations, simple exact solutions for Hydrodynamic lubrication. **[08 Hours]**

Unit 5

Boundary Layer Theory-Formation, growth and separation of boundary layer-Integral momentum principles to compute drag and lift forces-Mathematical models for boundary layer flows. smooth rough and transitional turbulent flow in pipes, pipe resistance equation for pipes design of pipe networks.
[08 Hours]

Learning Resources:

Text Books:

1. Philip M. Gerhart, John I. Hochstein, Andrew L. Gerhart, "Fundamentals of Fluid Mechanics", 9th Edition, Wiley, 2021
2. Fluid Mechanics Franck .M White Tata Mc GrawHill Publication 2011.

Reference Books:

1. Shames, "Mechanics of Fluids", McGraw Hill Book Co., New Delhi, 1988
2. Streeter V.L., Benjamin Wylie, "Fluid Mechanics", Mc Graw Hill Book Co., New Delhi, 1999.

Mechanics of Solids

MEC 304

Course Outcomes:

At the end of the course, the student shall be able to:

CO1	Apply the fundamental principles to estimate the deformation and stress of linear elastic solids under axial loading.
CO2	Calculate principal stresses and identify principal planes.
CO3	Construct shear force and bending moment diagrams
CO4	Evaluate bending stress in beams.
CO5	Calculate slope and deflection in beams.
CO6	Compute stress in shafts subjected to torsion.
CO7	Determine stress developed in pressurized thin cylinder.
CO8	Compare Euler's and Rankine's buckling load of columns under different end conditions.

Course Articulation Matrix:

	Program Outcomes [POs]												Program Specific Outcomes [PSOs]*			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	3	2									1	2	1		
CO 2	3	3	2									1	2	1		
CO 3	3	3	2									1	2	1		
CO 4	3	3	2									1	2	1		
CO 5	3	3	2									1	2	1		
CO 6	3	3	2									1	2	1		
CO 7	3	3	2									1	2	1		
CO 8	3	3	2									1	2	1		

Course Objectives

The course will enable the students to

- Understand the theory of linear elastic response of materials subjected to different types of loads
- Evaluate the deformation and stress of elastic materials under axial, torsional, and transverse loading conditions

- Construct shear force, and bending moment diagrams
- Familiarize the stress of pressurized cylinders
- Evaluate the buckling load of columns

Syllabus

Unit 1

Simple Stress and Strain: Introduction, Properties of materials, Stress, Strain, Hook's Law, Poisson's ratio, Stress-Strain Diagram for structural steel, Principles of superposition, Total elongation of tapering bars of circular and rectangular cross sections. Elongation due to self-weight, Composite sections, Volumetric strain, Elastic constants, Relationship among elastic constants, Thermal stresses in compound bars. Strain Energy & Impact loading. **[10 Hours]**

Unit 2

Compound Stresses: Introduction, Stress components on inclined planes, General two-dimensional stress system, Principal planes and stresses and Mohr's circle of stresses. Thin Cylinders and Shells: Analysis of thin cylindrical shells **[6 Hours]**

Unit 3

Bending Moment and Shear Force in Beams: Introduction, Types of beams, loadings and supports, Shear force in beam, bending moment in beam, Sign convention, Relationship between loading, shear force and bending moment, Shear force and bending moment equations, SFD and BMD with salient values for Cantilever beams, simply supported beams and Overhanging beams considering Point loads, UDL, UVL and Couple. Bending and shear stresses in beams. **[8 Hours]**

Unit 4

Deflection of beams: Introduction, Definition of Slope, Deflection, Elastic curve, Deflection using Macaulay's method, Moment Area method for prismatic beams subjected to transverse Point loads, UDL and Couple. **[6 Hours]**

Unit 5

Torsion of Circular Shafts: Introduction pure torsion, Torsion equation of circular shafts, Torsional rigidity and polar modulus, Power transmitted by shaft of solid and hollow circular sections. **[6 Hours]**

Unit 6

Elastic Stability of Columns: Introduction, Short and long columns, Buckling load, Euler's theory on columns, Derivation, Effective length, Slenderness ratio, Radius of gyration, Limitations of Euler's theory, Rankine's formula, Problems **[6 Hours]**

Textbook:

1. Ferdinand Beer & Russell Johnston – "Mechanics of Materials" - Tata Mc Graw Hill 2020, 8th Edition

Reference Books:

1. James M. Gere, Barry J. Goodno - ‘Mechanics of Materials’ - Cengage Learning Custom Publishing 2021, 9th Edition

2. R. C. Hibbeler, - ‘Mechanics of Materials’ - Prentice Hall - 2022 - 10th Edition

3. Egor. P. Popov – ‘Engineering Mechanics of Solids’ - Pearson Edu. India - 2015 - 2nd Edition

4. Mubeen – ‘Mechanics of Solids’ - Pearson India - 2012 - 2nd Edition

5. W.A.Nash, Schaum’s Outline Series – ‘Strength of Materials’ – 2019 – 7th Edition

MANUFACTURING PROCESS- I

MEC305

Course Outcomes:

At the end of the course, the student shall be able to:

CO1	Apply the principles of metal casting processes for ferrous and nonferrous materials involving the design of patterns, molds, and gating and riser system.
CO2	Prepare sand mold, perform casting trials with a non-ferrous material, and conduct a macroscopic inspection of the cast component.
CO3	Understand the principles of plastic manufacturing processes and select suitable processes for the given application.
CO4	Understand the principle of various metal-forming processes and analyze the concept of yield criteria and estimate the formability limits of different materials
CO5	Select suitable metals joining process for the given material and application.
CO6	Design of weld joints, selection of welding parameters, joining ferrous and non-ferrous materials using TIG and MIG welding processes, and macroscopic inspection of weldments.
CO7	Understand the principle of the powder metallurgy process and identify suitable applications.
CO8	Follow safety rules and standard codes of practice during machining.

Course Articulation Matrix:

	Program Outcomes [POs]												Program Specific Outcomes [PSOs]*			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	1	2	1		1	1		1	1		1	1	1	2	
CO 2	3	1	2	1		1	1		1	1		1	1	1	2	
CO 3	3	1	2			1	1		1	1		1	1	1	2	
CO 4	3	1	2	1		1	1		1	1		1	1	1	2	
CO 5	3	1	2	1		1	1		1	1		1	1	1	2	
CO 6	3	1	2	1		1	1		1	1		1	1	1	2	
CO 7	3	1	2			1	1		1	1		1	1	1	2	
CO 8						1	1	1	1	1		1	1	1	2	

Course Objectives

The course will enable the students to

- Impart knowledge of fundamental concepts and applications of metal casting, mold preparation with proper gating-riser system, and plastic manufacturing processes.
- Basic principles, effect of process parameters, forming load calculation, formability estimation, and applications of conventional and advanced forming processes.
- Principles, process parameters, and applications of fusion and solid-state welding processes and design of weld joints
- Principles and applications of powder metallurgy processes for producing net-shape parts from metal powders

Syllabus

Unit 1

Casting: Metal casting processes and equipment, shrinkage, principles of gating and riser design, Casting processes - sand, die, gravity, centrifugal, shell mold and Investment casting, Single crystal/ direct solidification processes, Squeeze casting, casting defects, remedies and inspection. **[10 Hours]**

Unit 2:

Metal forming: Plastic deformation and yield criteria; fundamentals of hot and cold working processes, bulk forming processes - forging, rolling, extrusion, drawing and sheet forming processes - shearing, deep drawing, bending, flow forming, advanced metal forming processes – severe plastic deformation- explosive, electro-hydraulic, magnetic pulse and hydroforming.
[10 Hours]

Unit 3:

Metal Joining Processes: Solid state welding process- diffusion, friction, and friction stir welding, Fusion Welding - arc welding, gas welding, resistance welding, submerged arc welding, high energy welding- Laser, Electron Beam, and Plasma, weld defects and inspection, Soldering, brazing, and adhesive bonding. **[10 Hours]**

Unit 4:

Powder Metallurgy: Powder metallurgy- process- powder production, compaction and sintering, applications. Introduction to additive manufacturing process and principles. **[4 Hours]**

Unit 5:

Processing of polymers and composites: Plastic manufacturing processes, calendaring, casting, forming, molding, extrusion, injection, and blow molding, thermoforming. Composite manufacturing techniques: Open and Closed molding, RTM, Hand layup, spraying, Injection molding, compression molding, filament winding, pultrusion. **[8 Hours]**

Textbooks:

1. Serope Kalpakjian and Steven R. Schmid – 'Manufacturing Engineering and Technology' - Prentice Hall - 2023 - 8th Edition in SI Units

Reference Books:

1. Amitabha Ghosh and A.K. Mallick, Manufacturing Science. Affiliated East-West Press Pvt. Ltd. 2010.

2. Mikell P Groover, Fundamentals of Modern Manufacturing: Materials, Processes and Systems, 7th Edition, Wiley, 2021.

MACHINE DRAWING AutoCAD

MEC306P

Course Outcomes:

At the end of the course, the student shall be able to:

CO1	Understand the standards for creating machine drawings.	Understand
CO2	Apply limits and tolerances to assemblies and choose the appropriate fit.	Apply
CO3	Develop solid models of machine components and assembly, and Construct sectional and orthographic views of components.	Develop
CO4	Apply CAD packages for solid/surface modeling of machine parts and create a bill of materials.	Apply
CO5	Interpret and apply the geometric dimensioning & Tolerancing symbols in the drawing and assembly of solid/surface models of machine components using a CAD package.	Apply

Course Articulation Matrix:

	Program Outcomes [POs]												Program Specific Outcomes [PSOs]*			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3				3	1			1	3		1	1	1		
CO 2	2				1	1			1	3		1	1	1		
CO 3	1		1		3	1			1	2		1	1	1		
CO 4	1				2	1			1	2		1	1	1		
CO 5	1		1		3	1			2	2		1	1	1		

1 - Slightly; 2 - Moderately; 3 – Substantially

Syllabus

Unit 1

Fundamentals of Machine Drawing: Standardization, Inter-changeability, Selective Assembly, Basic principles of GD&T (geometric dimensioning & tolerance), Limits, Fits, Tolerance, Tolerance of form and position, Grades of tolerance, Standard tolerances Machining symbols, Welding symbols, Surface finish indication, Functional and manufacturing datum, Riveted and butt Joints, Fasteners and keys.

Unit 2

Drawing of Machine Elements (Manual & Using Application Packages):
Application package Introduction: Drawing, Editing, Dimensioning, and Assembly.
Shaft joints: Cotter joint and knuckle joint.
Shaft coupling: Muff, Flanged, Flexible, Universal and Oldham's coupling.
Shaft bearing: Solid and bush bearing, Plummer block, Footstep bearing.
Pipe joint: Flanged joint, Socket and Spigot joint, Hydraulic joint, Union joint, Gland & Stuffing Box and Expansion joint.

Sheet metal surface modellings.

Unit 3

Assembly Drawings using prototypes (Manual & Using Application Packages):
Valves: Stop valve, relief valve, safety valve and non- return valve
Machine tool components: Drill Jig, Tail Stock, Tool post, machine vice and screw jack.
Engine: Piston and connecting rod.
Preparation of bill of materials and tolerance data
Project: Students will be assigned to assemble and create three dimensional and part drawings by following standard drawing practices.

Textbooks:

1. Gopalakrishna K. R., "Machine Drawing", 16th Edition, Subhas publishing House, 2002

Reference Books:

1. Narayana K.L., "Machine Drawing", 4th Edition, New Age International publishers, 2010
2. Gill P.S. "A Textbook of Machine Drawing", 18th Edition, S. K. Kataria& Sons, 2013
3. Bhat N.D., and Panchal, V.M., "Machine Drawing" 48th Edition, Charotar Publication House, 2013
4. Ajeet Singh, Machine drawing, 2nd edition, Tata McGraw Hill, India, 2012.

MATERIAL TESTING LABORATORY

MEC304P

Course Outcomes:

At the end of the course, the student shall be able to:

CO1	Determine the tensile properties and torsional shear strength of metals.	Evaluate
CO2	Evaluate the stiffness and rigidity of springs and modulus of elasticity of wooden beams.	Evaluate
CO3	Estimate the hardness, shear and impact strength of various materials.	Evaluate
CO4	Prepare the samples and characterize the microstructures of different ferrous and non-ferrous metals / alloys.	Analyze
CO5	Evaluate the effect of various heat treatments on the properties and hardenability of steel	Evaluate
CO6	Analyze the microstructure of the samples using SEM and XRD	Analyze
CO7	Identify the surface defects using NDT	Apply

Course Articulation Matrix:

	Program Outcomes [POs]												Program Specific Outcomes [PSOs]*			
	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3	PSO 4
CO 1	3	2	1	1	1	1	1		1	1			2	1		
CO 2	3	2	1	1	1	1	1		1	1			2	1		
CO 3	3	2	1	1	1	1	1		1	1			2	1		
CO 4	3	2	1	1	1	1	1		1	1			2		1	
CO 5	3	2	1	1	1	1	1		1	1			2		1	
CO 6	3	2	1	1	1	1	1		1	1			2		1	
CO 7	3	2	1	1	1	1	1		1	1			2		1	

1 - Slightly; 2 - Moderately; 3 – Substantially

Syllabus

a) Material testing:

Tension test on metals, Torsion test on mild steel rods, Tension and compression tests on springs (closed coil and open coil), Static bending test on wooden beams, Double shear test on mild steel specimens, Impact tests (Charpy and Izod), Hardness tests (Brinell and Rockwell tests).

b) Metallurgy:

1. Study of metallurgical microscope and sample preparation.
2. Study the microstructure of low, medium, high carbon steel and high-speed steel.
3. Study the microstructure of cast irons.
4. Study the microstructure of Aluminium alloys, copper alloys and Al Metal Matrix Composites.
5. Study the microstructure and hardness measurements of heat-treated steels.
6. Determination of the hardenability of Steels.
7. Scanning Electron Microscope (SEM): working principle and study of tensile fractured and wear tested samples
8. X-Ray Diffraction (XRD): working principle, structure factor and indexing BCC and FCC crystal structures
9. Introduction to Non-destructive testing.

Reference Books:

1. H. E. Davis, G. E. Troxell, G. F. W. Hauck, "The Testing of Engineering Materials", 4ed, McGraw-Hill 1982.
2. G. E. Dieter, "Mechanical Metallurgy", 3ed, McGraw-Hill Book, Co., New York, 1988.
3. P. G. Ormandy "An introduction to metallurgical laboratory techniques", 1st edition, Pergamon series , Canada, 1968, https://doi.org/10.1016/C2013-0-01529-0

List of Equipment required for meeting the COs

a) Material Testing

- Universal Testing Machine
- Deflection of beam
- Torsion test machine
- Brinell and Rockwell test machines
- Impact test machine•

b) Metallurgy

Metallurgical optical microscope

- Brinell hardness test
- Rockwell hardness tester
- Muffle furnace
- Jominy End Quench Test Apparatus
- SEM and XRD
- liquid penetrant test kit

List of Exercises

1. Determination of the tensile properties of metals.
2 .Determination of the stiffness and modulus of rigidity of helical springs.
3. Estimation of the modulus of elasticity of the given wooden beam .
4. Determination of the modulus of rigidity and torsional shear strength of the given material through a torsion test.
5. Find the shear strength of the given specimen.
6. Determination of the hardness of given materials .

7. Determination of the impact strength of the given specimen by the Izod and Charpy impact test.
8. Study of metallurgical microscope and sample preparation.
9. Microstructural examination of low, medium, high carbon steel and high-speed steel.
10. Microstructural examination of various cast irons in etched and unetched condition.
11. Microstructural examination of Aluminium alloys, copper alloys and Al Metal Matrix Composites.
12. Microstructural examination and hardness measurements of heat-treated steels.
13. Determination of the hardenability of Steels.
14. Scanning Electron Microscope (SEM): analyze tensile and wear tested samples .
15. X-Ray Diffraction (XRD): structure factor and indexing BCC and FCC patterns.
16. Identification of surface defects of the cast and welded samples using the liquid penetrant test.

Fluid Mechanics Lab

MEC303P

Pre-Requisites: **None**

Course Outcomes:

CO-1	Understanding of basic physics of fluids.
CO-2	Gaining knowledge to calculate and design engineering applications involving fluid.
CO-3	Understanding of analyzing flow systems in terms of mass, momentum, and energy balance.
CO-4	Use of different fluid flow measuring devices.
CO-5	Having knowledge about current research topics about fluid mechanics.

Course Articulation Matrix:

	Program Outcomes [POs]												Program Specific Outcomes [PSOs]*			
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	2					1	1		2	2	1		
CO2	3	3	3	3					1	1		2	2	1		
CO3	2	1	3	1	1				1	1		1	2	1		
CO4	2	1	3	2				1	1	1		1	2	1		
CO5	3	2	3	2	1				1	1		1	2	1		

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

List of Experiments:

1. Calibration of Bourdon pressure gauge with the help of Dead Weight Pressure gauge.
2. To determine the hydrostatic force and center of pressure due to water acting on a partially or fully submerged surface.

3. Determine the meta centric height of a floating body.
4. Verification of Bernoulli's Theorem.
5. Determination of Co efficient of Discharge of Venture-meter
6. Determination of Coefficient of discharge, coefficient of Contraction and co-efficient of velocity of orifice meter.
7. Determination of coefficient of discharge through rectangular notch.
8. Determination of coefficient of discharge through triangular notch.
9. To determine minor losses for flow through pipes.
10. Determination of coefficient of friction of flow through pipes.

Learning Resources:

Text Books:

1. Philip M. Gerhart, John I. Hochstein, Andrew L. Gerhart, "Fundamentals of Fluid Mechanics", 9th Edition, Wiley, 2021
2. Fluid Mechanics Franck .M White Tata Mc GrawHill Publication 2011.

Reference Books:

1. Shames, "Mechanics of Fluids", McGraw Hill Book Co., New Delhi, 1988
2. Streeter V.L., Benjamin Wylie, "Fluid Mechanics", Mc Graw Hill Book Co., New Delhi, 1999