SYLLABUS

For

B.Tech. PROGRAMME

in

MECHANICAL ENGINEERING

UNIVERSITY OF KASHMIR
SRINAGAR

JULY – 2026

(Applicable to Batch 2025 & Onwards)

Coordinator (DOME)
Dr. F. A. Najar.

Department of Mechanical Engineering
Institute of Technology, University of Kashmir
Zakura Campus, Srinagar

COURSE STRUCTURE, B.Tech MECHANICAL ENGINEERING
THIRD SEMESTER TO EIGHTH SEMESTER

Indicator Alphabit

E	Engineering Science Courses	L	Experiential Learning Course/ Lab Course
B	Basic Science Courses	H	Humanities and Social Sciences including
C	Professional Core Course	Y	Seminar
D	Professional Elective Course	P	Project work/Internship
O	Open Elective Course	A	Audit Course

ISE	Internal Semester Evaluation (50 *Marks*)	
	MSE	Mid Semester Evaluation (*35 Marks*)
	CA	Contineous Assessment (*Assignment + Quiz/ Viva Voce (10 Marks) + Attendence (5 Marks)*)
ESA	End Semester Evaluation	

Semester - 3 (*Three*)						Examination Scheme (*Distribution of Marks*)										
Course Code	Course Title	L	T	P	Credits	ISE (*Theory*) MSE	ISE (*Theory*) CA	ISE (*Theory*) Total	ISE (*Practical*) MSE	ISE (*Practical*) CA	ISE (*Practical*) Total	Internal (*Total*)	ESE (*Theory*)	ESE (*Practical*)	External (*Total*)	Total
BMECCDR325	Dynamics of Rigid Bodies	2	1	0	3	35	15	50	0	0	0	50	50	0	50	100
BMECCCM325	Computer Aided Drawing and Modelling	0	0	4	2	0	0	0	35	15	50	50	0	50	50	100
BMECCME325	Materials Engineering	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
BMECCET325	Engineering Thermoynamics	2	1	0	3	35	15	50	0	0	0	50	50	0	50	100
BMECCFM325	Fluid Mechanics	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
BMECCMP325	Metal Cutting and Machining Processes	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
		10	5	10	20											900
	Total Hours		25													

Semester - 4 (*Four*)						Examination Scheme (*Distribution of Marks*)										
Course Code	Course Title	L	T	P	Credits	ISE (*Theory*) MSE	ISE (*Theory*) CA	ISE (*Theory*) Total	ISE (*Practical*) MSE	ISE (*Practical*) CA	ISE (*Practical*) Total	Internal (*Total*)	ESE (*Theory*)	ESE (*Practical*)	External (*Total*)	Total
BMECBPD425	Partial Differential Equations, Laplace and Z-transform	2	1	0	3	35	15	50	0	0	0	50	50	0	50	100
BMECCMS425	Mechanics of Solids	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
BMECD**425	Professional Elective-I	1	0	2	2	35	15	50	35	15	50	100	50	50	100	200
BMECCTM425	Theory of Machines	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
BMECLFM425	Fluid Machinery	0	2	2	3	0	0	0	35	15	50	50	0	50	50	100
BMECCMC425	Metal Casting and Forming Processes	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
		9	6	10	20											1000
	Total Hours		25													

Semester - 5 (*Five*)						Examination Scheme (*Distribution of Marks*)										
Course Code	Course Title	L	T	P	Credits	ISE (*Theory*) MSE	ISE (*Theory*) CA	ISE (*Theory*) Total	ISE (*Practical*) MSE	ISE (*Practical*) CA	ISE (*Practical*) Total	Internal (*Total*)	ESE (*Theory*)	ESE (*Practical*)	External (*Total*)	Total
BMECBCA525	Complex Analysis and Special Functions	2	1	0	3	35	15	50	0	0	0	50	50	0	50	100
BMECCAC525	Automatic Control	2	0	2	3	15	35	50	35	15	50	100	0	50	50	150
BMECCHT525	Heat Transfer	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
BMECCAT525	Applied Thermodynamics	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
BMECCSM525	Structural Mechanics	2	1	0	3	35	15	50	0	0	0	50	50	50	100	150
BMECLMI525	Metrology & Instrumentation	0	2	2	3	0	0	0	35	15	50	50	0	50	50	100
		10	6	8	20											900
	Total Hours		24													

Semester - 6 (*Six*)						Examination Scheme (*Distribution of Marks*)										
Course Code	Course Title	L	T	P	Credits	ISE (*Theory*) MSE	ISE (*Theory*) CA	ISE (*Theory*) Total	ISE (*Practical*) MSE	ISE (*Practical*) CA	ISE (*Practical*) Total	Internal (*Total*)	ESE (*Theory*)	ESE (*Practical*)	External (*Total*)	Total
BMECHIE625	Industrial Engineering	2	0	2	3	35	15	50	35	15	50	100	50	50	100	200
BMECCMV625	Mechanical Vibrations	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
BMECLIC625	Internal Combustion Engines	0	2	2	3	0	0	0	35	15	50	50	0	50	50	100
BMECO**625	Open Elective-I	2	0	2	3	35	15	50	35	15	50	100	50	50	100	200
BMECCDM625	Design of Machine Elements	2	1	0	3	35	15	50	0	0	0	50	50	0	50	100
BMECCCF625	Compressible Fluid Flow	2	1	2	4	35	15	50	35	15	50	100	50	50	100	200
		10	5	10	20											1000
	Total Hours		25													

Semester - 7 (*Seven*)						Examination Scheme (*Distribution of Marks*)										
Course Code	Course Title	L	T	P	Credits	ISE (Theory)			ISE (Practical)			Internal (Total)	ESE (Theory)	ESE (Practical)	External (Total)	Total
						MSE	CA	Total	MSE	CA	Total					
BMECLCM725	Computer Aided Manufacturing	0	0	6	3	0	0	0	35	15	50	50	0	50	50	100
BMECLWT725	Welding Technology	0	0	4	2	0	0	0	35	15	50	50	0	50	50	100
BMECD**725	Professional Elective II	2	0	2	3	35	15	50	35	15	50	100	50	50	100	200
BMECLOD725	Operation and Diagnostics of Machines	0	2	2	3	0	0	0	35	15	50	50	0	50	50	100
BMECCMD725	Machine Design	2	1	0	3	35	15	50	0	0	0	50	50	0	50	100
BMECHOR725	Operations Research	2	1	0	3	35	15	50	0	0	0	50	50	0	50	100
BMECPPP725	Final Year Pre-Project	0	0	6	3	0	0	0	35	15	50	50	0	50	50	100
		6	4	20	20											800
	Total Hours	30														

Semester - 8 (*Eight*)						Examination Scheme (*Distribution of Marks*)										
Course Code	Course Title	L	T	P	Credits	ISE (Theory)			ISE (Practical)			Internal (Total)	ESE (Theory)	ESE (Practical)	External (Total)	Total
						MSE	CA	Total	MSE	CA	Total					
BMECHPM825	Introduction to Project Management	2	1	0	3	35	15	50	35	15	50	100	50	50	100	200
BMECO**825	Open Elective-II	2	0	2	3	35	15	50	0	0	0	50	50	0	50	100
BMECD**725	Professional Elective-III	2	0	2	3	35	15	50	35	15	50	100	50	50	100	200
BMECD**825	Professional Elective-IV	2	1	0	3	35	15	50	0	0	0	50	50	0	50	100
BMECPFP825	Final Year Project	0	0	14	7	0	0	0	35	15	50	50	0	50	50	100
BMECPIN825	Internship	0	0	0	1	0	0	0	35	15	50	50	0	50	50	100
		8	2	18	20											1000
	Total Hours	28														

Professional Elective Courses

Course Code	Course Title	L	T	P	Credits
	Professional Elective I				
BMECDPE425	Programming for Engineers	1	0	2	2
BMECDRE425	Renewable Energy Systems	2	0	0	2
BMECDMC425	Material Characterization Method	1	0	2	2
	Professional Elective II				
BMECDFT725	Fundamentals of Tribology	2	0	2	3
BMECDMC725	Microprocessors and Processor-Based Systems	2	0	2	3
BMECDRF725	Refrigeration	2	0	2	3
	Professional Elective III				
BMECDCE825	Cryogenic Engineering	2	0	2	3
BMECDHV825	Heating Ventilation and Air Conditioning	2	0	2	3
BMECDCM825	Composite Materials	2	0	2	3
	Professional Elective IV				
BMECDPP825	Power Plant Engineering	2	1	0	3
BMECDIC825	Introduction to Computational Mechanics	2	0	2	3
BMECDSP825	Solar PV Installation & Design	2	1	0	3

Open Elective Courses

Course Code	Course Title	L	T	P	Credits
	Open Elective I				
BMECOAM625	Additive Manufacturing	2	0	2	3
BMECODE625	Design of Experiment	2	1	0	3
BMECONM625	Numerical Methods for Engineers	2	0	2	3
	Open Elective II				
BMECONT825	Non-Destructive Testing	2	0	2	3
BMECOMS825	Mechatronic Systems	2	0	2	3
BMECOME825	Micro-Electro-Mechanical Systems	2	0	2	3
BMECORB825	Robotics	2	0	2	3

Note: Students can also choose Professional Electives courses from Swaym (Moocs) plateform. The list of MOOCs courses will be notified at the start of each semester.

Course Code	BMECCDR325				
Category	Professional Core courses				
Course Title	Dynamics of Rigid Bodies				
Scheme and Credits	L	T	P	Credits	Semester- 3 (*Three*)
	2	1	0	3	
Pre requisites	Engineering Mechanics				

Course Learning Outcomes (CLOs)

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

i) **CLO1:** ***Understand*** the planar motion of rigid bodies by determining displacement, velocity, acceleration, relative motion, and instantaneous center of rotation for bodies undergoing translation, rotation, and general plane motion *(L2)*

ii) **CLO2:** ***Compare*** the principles of three-dimensional rigid body kinematics to determine orientation, angular velocity, and angular acceleration using translating and rotating reference frames and Euler angles. ***(L2)***

iii) **CLO3:** ***Interpret*** the motion of planar rigid bodies by applying Newton–Euler equations, D'Alembert's principle, and inertia properties to solve force and acceleration problems involving translation, rotation, and general plane motion. ***(L5)***

iv) **CLO4:** ***Draw*** work–energy and impulse–momentum principles to analyze planar rigid body motion and solve engineering problems involving conservation of energy and momentum. ***(L3)***

v) **CLO5:** ***Assemble*** the three-dimensional dynamic behavior of rigid bodies using angular momentum, inertia tensor, Euler's equations of motion, and gyroscopic principles for engineering applications. ***(L6)***

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Kinematics of rigid bodies, translation and rotation about a fixed axis, Relative velocity and acceleration (rotating axes), Instantaneous center of rotation.
Module 2.	Translating and rotating reference frames, Euler angles, angular velocity, and acceleration.
Module 3.	Introduction to Kinetics of rigid bodies, force and acceleration, Moments and products of inertia, D'Alembert's principle, equations of motion, translation, fixed-axis rotation, and general plane motion.
Module 4.	Energy and Momentum Methods, Work and kinetic energy for a rigid body, Impulse and momentum for a rigid body, Conservation of momentum and energy.
Module 5.	Angular momentum, kinetic energy, and inertia tensor, Euler's equations of motion, Gyroscope motion and torque-free motion.

Activity Module (Internal Evaluation Only-10 Marks)

Activity	Example Task
Using the tools learned on Module 1, design a variety of items, including:	Identify examples of translational and rotational motion from everyday engineering systems like connecting rod of IC engine etc. using MATLAB
Using the tools learned on Module 2, design a variety of items, including:	Develop free-body diagrams for rigid bodies undergoing plane motion.
Using the tools learned on Module 3, design a variety of items, including:	Develop a MATLAB code to compute instantaneous center of rotation for mechanisms such as rolling wheels and connecting rods.
Using the tools learned on Module 4, design a variety of items, including:	Develop MATLAB code to compute angular velocity and acceleration from Euler angles and compare numerical and analytical results.
Using the tools learned on Module 5, design a variety of items, including:	Demonstrate gyroscopic precession using a bicycle wheel.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	3	2	2	2	0	0	0	1	1	0	1
CLO2	3	3	2	2	3	0	0	0	1	1	0	1

CLO3	3	3	3	2	3	1	1	0	1	1	1	1
CLO4	3	3	2	2	2	1	1	0	1	1	1	1
CLO5	3	3	3	3	3	1	1	0	1	1	0	2

S.No:	Text Books	Author	Publisher
	Engineering Mechanics: Dynamics	Anthony Bedford and Wallace Fowler	Pearson
2	Text book of Dynamics	F Chorlton	CBS Publishers
	References		
	Engineering Mechanics: Statics and Dynamics	R.C Hibbeler	Pearson
	Engineering Mechanics: Dynamics	J.L Meriam and L.G Kraige	Wiley
	Fundamentals of Dynamics & Analysis of Motion	R.M. Marcelo, Crespo Da Silva	Dover Publications Inc.

Course Code	**BMECCDR325**				
Category	**Professional Core courses**				
Course Title	**Dynamics of Rigid Bodies**				
Scheme and Credits	**L** 2	**T** 1	**P** 0	**Credits** 3	**Semester- 3 (*Three*)**
Pre requisites	**Engineering Mechanics**				

Course Learning Outcomes (CLOs)

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

i) **CLO1:** ***Understand*** the planar motion of rigid bodies by determining displacement, velocity, acceleration, relative motion, and instantaneous center of rotation for bodies undergoing translation, rotation, and general plane motion. ***(L2)***

ii) **CLO2:** ***Compare*** the principles of three-dimensional rigid body kinematics to determine orientation, angular velocity, and angular acceleration using translating and rotating reference frames and Euler angles. ***(L2)***

iii) **CLO3:** ***Interpret*** the motion of planar rigid bodies by applying Newton–Euler equations, D'Alembert's principle, and inertia properties to solve force and acceleration problems involving translation, rotation, and general plane motion . ***(L5)***

iv) **CLO4:** ***Draw*** work–energy and impulse–momentum principles to analyze planar rigid body motion and solve engineering problems involving conservation of energy and momentum. ***(L3)***

v) **CLO5:** ***Assemble*** the three-dimensional dynamic behavior of rigid bodies using angular momentum, inertia tensor, Euler's equations of motion, and gyroscopic principles for engineering applications. ***(L6)***

Theory Module (Internal and External Evaluation)

M.No:	Topic
Module 1.	kinematics of rigid bodies, translation and rotation about a fixed axis, Relative velocity and acceleration (rotating axes), Instantaneous center of rotation.
Module 2.	Translating and rotating reference frames, Euler angles, angular velocity, and acceleration.
Module 3.	Introduction to Kinetics of rigid bodies, force and acceleration, Moments and products of inertia, D'Alembert's principle, equations of motion, translation, fixed-axis rotation, and general plane motion.
Module 4.	Energy and Momentum Methods, Work and kinetic energy for a rigid body, Impulse and momentum for a rigid body, Conservation of momentum and energy.
Module 5.	Angular momentum, kinetic energy, and inertia tensor, Euler's equations of motion, Gyroscope motion and torque-free motion.

Activity Module (Internal Evaluation Only-10 Marks)

Activity	Example Task
Using the tools learned on Module 1, design a variety of items, including:	Identify examples of translational and rotational motion from everyday engineering systems like connecting rod of IC engine etc. using MATLAB
Using the tools learned on Module 2, design a variety of items, including:	Develop free-body diagrams for rigid bodies undergoing plane motion.
Using the tools learned on Module 3, design a variety of items, including:	Develop a MATLAB code to compute instantaneous center of rotation for mechanisms such as rolling wheels and connecting rods.
Using the tools learned on Module 4, design a variety of items, including:	Develop MATLAB code to compute angular velocity and acceleration from Euler angles and compare numerical and analytical results.
Using the tools learned on Module 5, design a variety of items, including:	Demonstrate gyroscopic precession using a bicycle wheel.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	3	2	2	2	0	0	0	1	1	0	1
CLO2	3	3	2	2	3	0	0	0	1	1	0	1
CLO3	3	3	3	2	3	1	1	0	1	1	1	1
CLO4	3	3	2	2	2	1	1	0	1	1	1	1
CLO5	3	3	3	3	3	1	1	0	1	1	0	2

S.No:	Text Books	Author	Publisher
1.	Engineering Mechanics: Dynamics	Anthony Bedford and Wallace Fowler	Pearson
2.	Text book of Dynamics	F Chorlton	CBS Publishers
	References	**Author**	**Publisher**
3.	Engineering Mechanics: Statics and Dynamics	R.C Hibbeler	Pearson
4.	Engineering Mechanics: Dynamics	J.L Meriam and L.G Kraige	Wiley
5.	Fundamentals of Dynamics & Analysis of Motion	R.M. Marcelo, Crespo Da Silva	Dover Publications Inc.

Course Code	**BMECCCM325**				
Category	**Professional Core courses**				
Course Title	**Computer Aided Drawing and Modelling**				
Scheme and Credits	L 0	T 0	P 4	Credits 2	Semester- 3 (*Three*)
Pre requisites	**Engineering Drawing, Computer Aided Drawing**				

Course Learning Outcomes (CLOs)

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

i) **CLO1:** ***Understand*** the principles of parametric CAD modelling and apply basic sketching techniques, geometric and dimensional constraints, reference geometry, and elementary solid modelling features such as Extrude, Cut, Fillet, Chamfer, and Hole to create simple three-dimensional engineering components. ***(L2)***

ii) **CLO2:** ***Develop*** engineering models by applying advanced sketching techniques, including spline-based modelling and image-based sketching, and create complex part geometries using appropriate modelling strategies. ***(L3)***

iii) **CLO3:** ***Construct*** engineering components using reference geometry, revolve, mirror, and pattern features, and apply advanced modelling operations such as Loft, Sweep, Boundary, Shell, and Draft to develop complex parametric models. ***(L3)*** *iv)* **CLO4:** ***Evaluate*** different CAD modelling approaches and select the most appropriate feature-based modelling strategy for engineering components based on geometry, design intent, manufacturability, and modelling efficiency. *(L5)*

v) **CLO5:** ***Assemble*** a multi-part CAD model by defining mates and constraints between components, generating exploded views, and producing a detailed assembly drawing complete with a bill of materials, and part callouts. *(L5)*

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Introduction to the CAD environment, creating sketches using basic geometric entities, construction lines, geometric and dimensional constraints, reference planes, and sketch editing. Creation of basic solid models using extrude, cut, fillet, chamfer, and hole features, editing models, modifying features, and assigning material and appearance properties.
Module 2.	Creation of complex sketches using spline tools, importing and scaling reference images, tracing geometry, sketch repair, and preparing sketches for three-dimensional modeling.
Module 3.	Creation of reference planes, axes, and coordinate systems. Development of axisymmetric models using revolve features, application of mirror, linear pattern, circular pattern, and sketch pattern tools to create symmetric and repetitive features.
Module 4.	Creation of complex models using loft, sweep, boundary, and revolve features, use of guide curves, multiple profiles, shell, draft, thin features, and advanced reference geometry for developing engineering components.
Module 5.	Fundamentals of 3D scanning, point cloud acquisition, mesh generation (STL), mesh editing, noise filtering, hole filling, surface reconstruction, and importing scanned data as reference geometry for reverse engineering and model reconstruction.

Activity Module (Internal Evaluation only-10 Marks)

Activity	Example Task
Create parametric 3D models of basic mechanical components by applying the tools learned in Module 1.	Washer, spacer, bush, shaft, flange, L-bracket, base plate, pulley, and simple support bracket in SolidWorks/Fusion 360.
Develop engineering models by applying the advanced sketching and image-based modelling techniques learned in Module 2.	Cam profile, gasket, handwheel, airfoil profile, fan blade, and institute logo converted into a 3D model in SolidWorks/Fusion 360.
Develop engineering components by applying the reference geometry and pattern features learned in Module 3.	Bolt flange, chain sprocket, wheel hub, perforated plate, cooling fin, and simple gear blank in SolidWorks/Fusion 360.
Perform reverse engineering by applying the concepts learned in Module 5.	Pipe elbow, nozzle, hopper, bottle, funnel, impeller (basic), and screwdriver handle.
Using the tools learned on Module 5, design a variety of items, including:	Scan and reconstruct a spanner, machine knob, pipe fitting, valve handle, bearing housing, or simple bracket using a 3D scanner or photogrammetry.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	2	0	3	0	0	0	1	1	0	1
CLO2	3	3	3	0	3	1	0	0	1	1	0	2
CLO3	3	3	2	3	3	1	1	0	1	1	1	2
CLO4	3	3	3	3	3	1	1	1	1	2	2	3
CLO5	3	3	3	3	3	1	1	1	1	2	2	3

S.No:	Text Books	Author	Publisher
1.	SolidWorks 2024: A Power Guide for Beginners and Intermediate Users	Sandeep Dogra	CADArtifex, 2024

2.	Autodesk Fusion 360: A Power Guide for Beginners and Intermediate Users	Sandeep Dogra & John Willis	CADArtifex, 2024
	References		
1.	Reverse Engineering: An Industrial Perspective	Vinesh Raja & Kiran J. Fernandes	Springer, 2008
2.	Engineering Design Graphics with SolidWorks 2022	James D. Bethune	Pearson, 2022
3.	3D Scanning and Printing for the Engineering Classroom (MIT OCW RES.16-002 Course Notes)	Andy G. Eskenazi	MIT OpenCourseWare, 2024

Course Code	**BMECCME325**				
Category	**Professional Core courses**				
Course Title	**Materials Engineering**				
Scheme and Credits	**L**	**T**	**P**	**Credits**	**Semester- 3 (Three)**
	2	**1**	**2**	**4**	
Pre-requisites	-				

Course Learning Outcomes (CLOs)

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

i) **CLO1:** Understand the classification, crystal structures, properties, imperfections, diffusion mechanisms, deformation behaviour, phase transformations, and heat treatment of engineering materials. ***(L2)***

ii) **CLO2:** Compare the structure, properties, processing methods, and applications of metals, ceramics, polymers, composites, and advanced engineering materials. ***(L4)***

iii) **CLO3:** Interpret crystallographic directions and planes, X-ray diffraction data, diffusion behaviour, stress–strain curves, phase diagrams, and microstructural evolution in engineering materials. ***(L4)***

iv) **CLO4:** Draw unit cells, crystal structures, crystallographic planes and directions, stress–strain curves, phase diagrams, iron–carbon equilibrium diagram, and representative microstructures of engineering materials. ***(L3)***

v) **CLO5:** Assemble the knowledge of crystal structure, defects, diffusion, deformation, strengthening mechanisms, phase transformations, and heat treatment to select suitable engineering materials for mechanical engineering applications. ***(L5)***

Theory Module(Internal and External Evaluation)

M.No:	**Topic**
Module 1.	Historical perspective, classification of engineering materials, advanced engineering materials (smart materials, nanomaterials, biomaterials and shape memory alloys), atomic structure and bonding in solids, crystal structures of metals, unit cells, face-centered cubic (FCC), body-centered cubic (BCC) and hexagonal close-packed (HCP) crystal structures, density calculations for metals, ceramic crystal structures, density calculations for ceramics, polymorphism, allotropy, crystal systems, lattice parameters. .
Module 2.	Crystallographic directions, crystallographic planes, Miller indices, linear atomic density, planar atomic density, close-packed crystal structures, single crystals, polycrystalline materials, anisotropy, principles of X-ray diffraction, Bragg's law, determination of crystal structures, non-crystalline solids, amorphous materials, imperfections in solids, point defects, line defects, surface defects, volume defects, grain size, grain size determination, diffusion mechanisms, diffusion in solids, Fick's first and second laws, steady-state diffusion, non-steady-state diffusion, factors influencing diffusion.
Module 3.	Stress-strain behaviour, elastic deformation, plastic deformation, mechanical properties, hardness, deformation mechanisms, slip systems, plastic deformation of single and polycrystalline metals, deformation by twinning, strengthening mechanisms, grain size strengthening, solid solution strengthening, strain hardening, recovery, recrystallization, grain growth, fracture, ductile and brittle fracture, fatigue, creep and wear.
Module 4.	Phase concepts, solubility limits, phase equilibria, unary phase diagrams, binary phase diagrams, interpretation of phase diagrams, lever rule, iron-carbon phase diagram, microstructure of iron-carbon alloys, development of microstructure in iron-carbon alloys, heat treatment of steels, annealing, normalizing, hardening and tempering. .

Module 5.	Classification of polymers, thermoplastic polymers, thermosetting polymers, polymer crystallinity, polymer crystal structures, engineering ceramics, glasses, material selection for engineering applications, sustainability and recycling of engineering materials.

Activity Module (Internal Evaluation Only-10 Marks)

Activity	Example Task
Using the tools learned on Module 1, design a variety of items, including:	Construct BCC, FCC, and HCP crystal models using model kits or CAD software, identify unit cell parameters, and calculate the theoretical density of metallic and ceramic materials using MATLAB, Python, or Excel.
Using the tools learned on Module 2, design a variety of items, including:	Determine crystallographic directions and planes, calculate linear and planar atomic densities, simulate X-ray diffraction patterns using crystallographic software, and compare experimental and theoretical results.
Using the tools learned on Module 3, design a variety of items, including:	Solve steady-state and non-steady-state diffusion problems using MATLAB, Python, or Excel based on Fick's laws, and analyze the influence of temperature and time on diffusion behaviour
Using the tools learned on Module 4, design a variety of items, including:	Analyze experimental stress–strain data to determine elastic modulus, yield strength, and toughness, compare strengthening mechanisms, and evaluate the effect of heat treatment on mechanical properties using spreadsheet or computational tools.
Using the tools learned on Module 5, design a variety of items, including:	Use computational tools to interpret binary and iron–carbon phase diagrams, apply the lever rule to calculate phase fractions, predict microstructures under different cooling conditions, and correlate phase composition with mechanical properties.

Practical Module (Internal and External Evaluation)

M.No:	Experiments
Module 1.	To study 2D & 3D lattices.
Module 2.	To study crystal structures using appropriate models.
Module 3.	To study Bravais Lattices using appropriate models.
Module 4.	To study crystal imperfections using appropriate models.
Module 5.	To study three dimensional close packing using appropriate models.
Module 6.	Specimen preparation for micro structural examination.
Module 7.	To study microstructure of metals/alloys.
Module 8.	To study Heat Treatment Processes of steel.
Module 9.	To study creep behaviour of a given specimen(e.g. lead, zinc, solder wire).

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	1	0	0	0	0	0	0	0	3	2
CLO2	3	2	2	1	0	1	2	0	0	0	3	2
CLO3	2	3	2	3	2	0	0	0	0	1	2	3
CLO4	2	2	3	2	2	0	0	0	0	1	2	2
CLO5	3	3	3	2	2	1	2	1	1	1	3	3

S.No:	Text Books	Author	Publisher
1.	Fundamentals of Materials Science and Engineering	W.DJohn Wiley & Sons, 2011	John Wiley & Sons
	References	**Author**	**Publisher**
2.	Mechanical Metallurgy	George E. Dieter	McGraw Hill
3.	Physical Metallurgy	Cahn. R.W., Haasen. P	North-Holland

Course Code	BMECCET325				
Category	Professional Core courses				
Course Title	Engineering Thermodynamics				
Scheme and Credits	L	T	P	Credits	Semester- 3 (*Three*)
	2	1	0	3	
Pre requisites	Mathematics, Physics and Chemistry				

Course Learning Outcomes (CLOs)

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

i) **CLO1:** Explain the fundamental concepts of thermodynamics, thermodynamic properties, equations of state, and behaviour of pure substances and gas mixtures. ***(L2)***

ii) **CLO2:** Apply the first law of thermodynamics to analyze energy interactions in closed and open systems ***(L3)***

iii) **CLO3:** Analyze thermodynamic systems using the second law, entropy, and availability concepts. ***(L4)***

iv) **CLO4:** Analyze entropy changes, exergy, and second-law efficiency using thermodynamic property diagrams. ***(L4)***

v) **CLO5:**Apply thermodynamic property relations, Maxwell's relations, Clausius–Clapeyron equation, and Joule–Thomson coefficient to solve engineering thermodynamics ***(L3)***

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1.	Review of basic concepts of thermodynamics, thermodynamic systems and surroundings, properties and state of a system, thermodynamic equilibrium, Zeroth law of thermodynamics, concept of temperature and heat, thermometry and temperature scales, thermodynamic properties of pure substances, phase rule, P–V, P–T, T–V and PVT surfaces, ideal and real gases, equations of state, Avogadro's law, Van der Waals equation of state, compressibility factor, generalized compressibility charts.
Module 2.	Thermodynamic cycles, closed and open systems, first law of thermodynamics, internal energy, enthalpy, specific heats, energy balance for closed systems, control volume analysis, steady-flow energy equation, engineering applications.
Module 3.	Second law of thermodynamics, Kelvin–Planck and Clausius statements, heat engines, Carnot theorem, Carnot cycle, refrigerators and heat pumps, Clausius inequality, entropy, principle of increase of entropy, reversible and irreversible processes, entropy generation, second law analysis, availability, irreversibility, Gibbs free energy.
Module 4.	Entropy change of pure substances, entropy change of ideal gases, property diagrams, T–S diagram, h–s (Mollier) diagram, reversible steady-flow work, exergy, exergy balance for closed and open systems, exergy destruction, second law efficiency, engineering applications of exergy analysis.
Module 5.	Exact differentials, thermodynamic property relations, Maxwell's relations, Tds equations, Clausius–Clapeyron equation, Joule–Thomson coefficient, Joule–Thomson expansion.

Activity Module (Internal Evaluation Only-10 Marks)

Activity	Example Task
Using the tools learned on Module 1, design a variety of items, including:	Determine the properties of pure substances and gas mixtures, generate P–V and P–T plots, compare ideal and real gas behaviour using equations of state, and compute compressibility factors using Python, MATLAB, or Excel.
Using the tools learned on Module 2, design a variety of items, including:	Perform energy balance calculations for closed systems and steady-flow devices such as nozzles, turbines, compressors, pumps, and heat exchangers using analytical or computational methods, and compare the results.
Using the tools learned on Module 3, design a variety of items, including:	Evaluate the performance of heat engines, refrigerators, and heat pumps by calculating entropy generation, irreversibility, thermal efficiency, and second-law efficiency using Python, MATLAB, or Excel.
Using the tools learned on Module 4, design a variety of items, including:	Plot T–S and h–s diagrams, perform exergy analysis of engineering systems, determine exergy destruction and availability, and interpret the results using computational tools.
Using the tools learned on Module 5, design a variety of items, including:	Solve engineering problems involving Maxwell's relations, Clausius–Clapeyron equation, Joule–Thomson coefficient, and thermodynamic property relations using analytical methods or computational tools such as Python, MATLAB, or Excel. .

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	2	0	3	0	0	0	0	0	0	2
CLO2	2	3	3	0	3	0	0	0	0	0	0	2
CLO3	2	3	2	3	3	0	2	0	0	2	0	3
CLO4	3	2	3	0	3	2	0	2	0	3	0	0
CLO5	3	3	3	2	3	2	2	0	3	3	2	3

S.No:	Text Books	Author	Publisher
1.	Engineering Thermodynamics	Nag.P.K.	Tata McGraw-Hill
2.	Fundamentals of Thermodynamics	R. E. Sonntag, C. Borgnakke, & G. J. V Wylen.	John Wiley & Sons.
	References	**Author**	**Publisher**
1.	Thermodynamics, An Engineering Approach	Cengel,	Tata McGraw-Hill
2.	Fundamentals of Engineering Thermodynamics	Moran, J. Shapiro, H. N., Boe□ner, D. D., & M. Bailey	John Wiley & Sons.

Course Code	BMECCFM325				
Category	Professional Core courses				
Course Title	Fluid Mechanics				
Scheme and Credits	L	T	P	Credits	Semester- 3 (*Three*)
	2	1	2	4	
Pre requisites	Engineering Mechanics				

Course Learning Outcomes (CLOs)

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

i) **CLO1:** ***Understand*** the fundamental concepts of fluid mechanics, including fluid properties, fluid statics, and fluid kinematics. ***(L2)***

ii) **CLO2:** ***Compare*** different fluid flow phenomena, pressure measurement techniques, and methods of fluid flow analysis for engineering applications. ***(L2)***

iii) **CLO3:** ***Interpret*** fluid flow behavior using conservation laws, Bernoulli's equation, momentum principles, and Navier–Stokes concepts to evaluate engineering systems *(L5)*.

iv) **CLO4:** ***Draw*** streamlines, flow nets, velocity profiles, and boundary layer representations for different fluid flow conditions. ***(L3)***

v) **CLO5:** ***Assemble*** the principles of dimensional analysis, similarity, internal and external flows to develop solutions for practical fluid engineering problems. ***(L6)***

Theory Module(Internal and External Evaluation)

M.No:	Topic
Module 1	Scope and applications of fluid mechanics, fluid as a continuum, fluid properties (density, specific gravity, specific weight, viscosity, compressibility, vapor pressure, surface tension), Newtonian and non-Newtonian fluids, methods of analysis (system and control volume), pressure measurement and manometry.
Module 2.	Pressure variation in static fluids, hydrostatic forces on plane and curved surfaces, buoyancy and stability of floating and submerged bodies, metacentric height, Eulerian and Lagrangian descriptions, velocity and acceleration fields, streamlines, pathlines, streaklines, continuity equation, rotation and vorticity, stream function and velocity potential, flow nets.

Module 3.	Reynolds Transport Theorem, conservation of mass, momentum and energy, Bernoulli equation and its applications, flow measurement devices, limitations of Bernoulli's equation.
Module 4.	Differential continuity equation, Euler's equation of motion, Navier–Stokes equations, exact solutions for Couette and Poiseuille flows, Darcy–Weisbach equation, major and minor losses in pipe flow, pipe systems in series and parallel.
Module 5.	Dimensional homogeneity, Buckingham π theorem, geometric, kinematic and dynamic similarity, model and prototype studies, boundary layer theory, laminar and turbulent boundary layers, flow over flat plates, cylinders and airfoils, lift and drag.

Activity Module (Internal Evaluation Only-10 Marks)

Activity	Example Task
Using the tools learned on Module 1, design a variety of items, including:	Develop a simple MATLAB/Python program to calculate hydrostatic pressure at different depths and plot pressure variation with depth for water, oil, and mercury.
Using the tools learned on Module 2, design a variety of items, including:	Use MATLAB/Python to generate streamlines and velocity vectors for a given 2D velocity field and interpret the flow pattern.
Using the tools learned on Module 3, design a variety of items, including:	Create a program in MATLAB/Python to determine flow rate through a Venturimeter using Bernoulli's equation and study the effect of pressure difference on discharge.
Using the tools learned on Module 4, design a variety of items, including:	Develop a MATLAB/Python program to calculate Reynolds number and classify the flow as laminar, transitional, or turbulent for different pipe diameters and flow rates.
Using the tools learned on Module 5, design a variety of items, including:	Develop a MATLAB/Python/Excel-based program to evaluate Reynolds, Froude, Weber, and Mach numbers for engineering applications such as pipe flow *etc.* determine the appropriate similarity criterion for model testing.

Practical Module (Internal and External Evaluation)

M.No:	Experiments
Module 1.	Measurement of viscosity
Module 2.	Study of pressure measuring devices
Module 3.	Determination of metacentric height
Module 4.	Hydrostatics force on flat surfaces/ curved surfaces
Module 5.	Verification of Bernoulli's theorem
Module 6.	Determination of friction factor as a function of Reynolds number in pipe flow
Module 7.	Determination of coefficient of discharge of Venturimeter/ Orifice meter
Module 8.	Studying laminar-turbulent transition for flow in a tube
Module 9.	Determination of friction factor as a function of Reynolds number in pipe flow
Module 10.	Flow Visualisation around a body/ over surface
Module 11	Boundary layer flow over a flat plate

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	2	0	3	0	0	0	0	0	0	2
CLO2	2	3	3	0	3	0	0	0	0	0	0	2
CLO3	2	3	2	3	3	0	2	0	0	2	0	3
CLO4	3	2	3	0	3	2	0	2	0	3	0	0
CLO5	3	3	3	2	3	2	2	0	3	3	2	3

S.No:	Text Books	Author	Publisher
1.	Introduction to Fluid Mechanics	Fox, R. W., McDonald, A. T., & Pritchard, P. J.	Wiley
2.	Introduction to Fluid Mechanics and Fluid Machines	S K Som, Gautam Biswas, S Chakraborty	McGraw Hill
	References		
3.	Fluid Mechanics	Munson | Okiishi | Huebsch | Roth Mayer	Wiley

4.	Fluid Mechanics	Dr. Bansal, R.K	Lakshmi Publications
5.	Fluid Mechanics and hydraulics	Dr. Jagadishlal	Metropolitan Book Co-Ltd., 1997
6.	Fluid Mechanics: Fundamentals and Applications.	Yunus A. Cingel John M.Oimbala.	McGraw Hill
7.	Fluid Mechanics	John F. Douglas, Janul and M.Gasiosek and john A.Swaffield	Pearson Education Asia,

Course Code	**BMECCMP325**
Category	**Professional Core courses**
Course Title	**Metal Cutting and Machining Processes**
Scheme and Credits	**L** 2 **T** 1 **P** 2 **Credits** 4 — **Semester- 3 (*Three*)**
Pre requisites	**Engineering Workshop, Materials Engineering**

Course Learning Outcomes (CLOs)

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

i) **CLO1:** ***Understand*** machining processes, chip formation, tool materials, grinding, etc. ***(L2)***

ii) **CLO2:** ***Compare*** orthogonal *vs.* oblique cutting, EDM vs. ECM, honing vs. lapping, polishing vs. buffing, conventional vs. non-conventional machining. ***(L2)***

iii) **CLO3: Interpret** Merchant Force Circle, tool life equations, grinding forces, machining economics, and process performance. ***(L5)***

iv) **CLO4: Draw** single-point cutting tool geometry, Merchant Force Circle, chip formation, grinding wheel, EDM, ECM, LBM, honing, lapping, etc. ***(L3)***

v) **CLO5: Assemble** machining operations by selecting suitable tools, machining processes, cutting parameters, and finishing methods for a given component. ***(L6)***

Theory Module(Internal and External Evaluation)

M.No:	**Topic**
Module 1.	Machining Processes: Mechanics of Cutting; Geometry of Single-point Cutting Tool, Mechanism in Chip Formation, Types of Chips, Orthogonal and Oblique Cutting, Cutting Forces and Merchant Force Circle Diagram, Shear and Friction angle, Shear and Chip Velocity, Energy in Shear and Friction Plane,
Module 2.	Materials and Life of Cutting Tool; Composition and Properties of Tool Materials, Tool Life; Various Failures in Cutting Tool, Calculation of Tool life (Taylor's Tool Life Equation), Description of Practical Machining Processes; Process Geometry, Process Parameters for Turning and related machining operations, Economics of Cutting.
Module 3.	Abrasive Machining Processes: Need and Classifications; Abrasive Grinding: Wheel Specification, Wheel Life, Balancing, Truing and Dressing of Wheels, Classifications of Abrasive Grinding Processes, Chipping action in grinding, Calculation of Material Removal Rate, Forces and Power, Heat and Temperature in Abrasive Grinding, Working Principle and Applications of Grinding Processes for Prismatic and Rotational Parts.
Module 4.	Abrasive Finishing Processes: Conventional Abrasive Finishing: Honing, Lapping, Polishing and Buffing, Modern Abrasive Finishing: Abrasive Flow Finishing, Magnetic Abrasive Finishing and Magnetic Float Finishing.
Module 5.	Non-conventional Machining Processes: Need and Classification of Mechanical Machining Processes,, Electrochemical Processes, Electro-Thermal & Optical Processes, Process Principle, Equipments and Applications

Activity Module (Internal Evaluation Only-10 Marks)

Activity	Example Task

Using the tools learned on Module 1, design a variety of items, including:	Simulation of Orthogonal Cutting to Determine Cutting Forces and Merchant Circle Parameters (Using MATLAB/Excel)
Using the tools learned on Module 2, design a variety of items, including:	Simulation of Tool Life Prediction Using Taylor's Tool Life Equation *(Using MATLAB/Excel)*
Using the tools learned on Module 3, design a variety of items, including:	Computational Analysis of Grinding Wheel Speed and Depth of Cut on Surface Finish (Using MATLAB/Excel)
Using the tools learned on Module 4, design a variety of items, including:	Simulation of Material Removal during Honing and Lapping Processes (Using MATLAB/Excel)
Using the tools learned on Module 5, design a variety of items, including:	Computational Analysis of Electrochemical Machining (ECM) Material Removal Rate Using Faraday's Law (Using MATLAB/Excel)

Practical Module (Internal and External Evaluation)

M.No:	Experiments
Module 1.	To study the geometry of a single-point cutting tool.
Module 2.	To investigate the effect of machining process parameters on the surface roughness of machined components.
Module 3.	To compare the theoretical and experimental machining time in the turning operation.
Module 4.	To make a job as per drawing using a surface grinding machine. Write the process sheet and draw the sketches of the machine tool and tools used.
Module 5.	To study the Abrasive Flow Finishing process and evaluate material removal
Module 6.	To produce a cavity on a conductive workpiece using EDM.
Module 7.	To study the effect of discharge current on MRR during EDM.
Module 8.	To determine electrode wear during EDM.
Module 9.	To compare machining performance using copper and graphite electrodes using EDM.
Module 10.	To identify machining parameters for maximum MRR and minimum tool wear.

CLO-PLO Mapping Matrix

CLO \ PLO	PLO1	PLO2	PLO3	PLO4	PLO5	PLO6	PLO7	PLO8	PLO9	PLO10	PLO11	PLO12
CLO1	3	2	1	1	1	0	1	0	0	1	0	1
CLO2	3	3	1	1	1	0	1	0	0	1	0	1
CLO3	3	3	2	3	2	0	1	0	0	1	0	1
CLO4	2	2	3	1	3	0	0	0	0	2	0	1
CLO5	3	3	3	2	2	0	2	0	1	2	2	2

S.No:	Text Books	Author	Publisher
1.	Fundamentals of Modern Manufacturing: Materials Processes and Systems	M. P. Groover	John Wiley and Sons
2.	Manufacturing Technology: Volume 2	P N Rao	Tata McGraw Hill
3.	Manufacturing Science	Ghosh and Mallik	East West Press.
	References		
1.	Introduction to Machining Science	G. K. Lal	New Age International
2.	Fundamentals of Machining Processes	Hassan El-Hofy	Taylor and Francis.
3.	Rapid Prototyping: Principles and Applications	Rafiq Noorani	Wiley International.