SEMESTER 3

25UMGT301	FOURIER TRANSFORMS AND COMPLEX ANALYSIS	Category	L	T	P	R	Credit	Year of Introduction
		BSC	3	0	0	0	3	2025

Preamble: This course introduces basic ideas of Fourier transforms which are widely used in the modelling and analysis of a wide range of physical phenomena and has got application across all branches of engineering. To understand the basic theory of functions of a complex variable, residue integration and conformal transformation.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Determine the Fourier transforms of functions and apply them to solve problems arising in engineering.	K3 Apply
CO2	Explain the analyticity of complex functions and apply it in Conformal mapping.	K3 Apply
CO3	Compute complex integrals using Cauchy's integral theorem and Cauchy's integral formula.	K3 Apply
CO4	Explain the series expansion of complex function about a singularity and apply residue theorem to compute real integrals.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	3	3	2	2	-	-	-	-	-	-	1
CO2	3	3	2	2	-	-	-	-	-	-	1
CO3	3	3	2	2	-	-	-	-	-	-	1
CO4	3	3	2	2	-	-	-	-	-	-	1
Avg	3	3	2	2	-	-	-	-	-	-	1

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*			*	

CO2	*	*	*	*	*			*	
CO3	*	*	*	*	*			*	
CO4	*	*	*	*	*			*	

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*			*	

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	**40**	**60**	**2.5 hrs**

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (10hrs)

Fourier integral, from Fourier series to Fourier integral Fourier cosine and and Sine integrals, Fourier Cosine and Sine Transform, Linearity, Transforms of Derivatives, Fourier Transform and its inverse, Linearity, Transforms of Derivative.

(Text1: Relevant topics from sections11.7, 11.8, 11.9)

Module 2 (10hrs)

Complex Function, Limit, Continuity, Derivative, Analytic functions, Cauchy-Riemann Equations (without proof), Laplace's Equations, Harmonic functions, Finding harmonic conjugate, Conformal mapping, Mappings of $w=z^2$, $w=e^z$, $w=\frac{1}{z}$, $w=\sin z$.

(Text1: Relevant topics from sections 13.3, 13.4, 17.1, 17.2, 17.4)

Module 3 (11hrs)

Complex Integration: Line integrals in the complex plane (Definition & Basic properties), First evaluation method, Second evaluation method, Cauchy's integral theorem (without proof) on simply connected domain, Independence of path, Cauchy integral theorem on multiply connected domain (without proof), Cauchy Integral formula (without proof).

(Text1: Relevant topics from sections14.1, 14.2, 14.3)

Module 4 (11hrs)

Taylor series and Maclaurin series, Laurent series (without proof), Singularities and Zeros – Isolated Singularity, Poles, Essential Singularities, Removable singularities, Zeros of Analytic functions – Poles and Zeros, Formulas for Residues, Residue theorem (without proof), Residue Integration- Integral of Rational Functions of $cos\theta$ and $sin\theta$.

(Text1: Relevant topics from sections 15.4, 16.1, 16.2, 16.3, 16.4)

Textbook

1.Kreyszig, E. (2016). *Advanced engineering mathematics* (10th ed.). John Wiley & Sons.

Reference Books

1. Zill, D. G., & Shanahan, P. D. (2015). *Complex analysis: A first course with applications* (3rd ed.). Jones & Bartlett Learning.

2. Ramana, B. V. (2023). *Higher engineering mathematics* (39th ed.). McGraw-Hill Education.

3. Grewal, B. S. (2018). *Higher engineering mathematics* (44th ed.). Khanna Publishers.

SEMESTER EXAMINATION - MODEL QUESTION PAPER

(STC 2025 SCHEME)

Course Code	**25UMBT301**
Course Name	**FOURIER TRANSFORMS AND COMPLEX ANALYSIS**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1	Find the Fourier cosine integral of f(x)=$\begin{cases} 1 \ , & if\ \lvert x\rvert < 1 \\ 0 & ,otherwise \end{cases}$	3	1	L2
2	Find the Fourier transform of f(x)=$\begin{cases} x, & if\ \lvert x\rvert < 1 \\ 0 & ,otherwise \end{cases}$	3	1	L2
3	Show that the function f(z)= $\frac{\bar{z}}{z}$ does not have a limit as z=0	3	2	L3
4	Check whether the function u(x ,y) = xy^2 is the real art of an analytic function.	3	2	L3

5	Evaluate $\int_c \|z\|dz$ where c is the line segment joining -i and i	3	3	L3
6	Evaluate $\int_c \frac{z^2}{z^2-1}dz$ where c is the unit circle	3	3	L3
7	Find the Taylor series expansion of f(z)= sin z about z= $\frac{\pi}{4}$	3	4	L2
8	Find pole and residue of $\tan z$	3	4	L2
	Part B (*Answer any one full question from each Module. Each carries 9 marks*)			
	Module 1			
Qn No.	Question	Marks	CO	BL
7(a)	Find the Fourier cosine integral of the function f(x)= e^{-ax},x>0 and hence show that $\int_0^\infty \frac{\cos\omega x}{1+\omega^2}d\omega = \frac{\pi}{2}$	5	1	L3
(b)	Find the Fourier sine transform of the function f(x)= $\begin{cases} 1\ , & 0<x<1 \\ -1, & 1<x<2 \\ 0, & x>2 \end{cases}$	4	1	L2
	OR			
8(a)	Find the Fourier transform of f(x)= $e^{-\alpha\|x\|}, \alpha > 0$	5	1	L3
(b)	Find the Fourier sine integral of f(x)= $\begin{cases} \sin x\ , 0 \le x \le \pi \\ 0\ , x > \pi \end{cases}$	4	1	L2
	MODULE-2			
9(a)	Show that f(z)= $\sin z$ is differentiable everywhere. and find its derivative	5	2	L2
(b)	Show that u= $y^2 - 3x^2y$ is harmonic. and hence find the analytic function and harmonic conjugate	4	2	L3
	OR			
10(a)	Find the analytic function whose imaginary part is $\frac{x-y}{x^2+y^2}$	5	2	L2
(b)	Find the image of the infinite strip $\frac{1}{4} < y < \frac{1}{2}$	4	2	L3
	MODULE-3			
11(a)	Solve f(z)= $x^2 + ixy$ from A(1,1) to B(2,4) along the curve x=t and y=t	5	3	L3
(b)	Solve $\int_c \frac{z+4}{z^2+2z+5}\, dz$ where c is |z+1-i| = 2	4	3	L3
	OR			

12(a)	Solve $\int_c \frac{e^z}{z^2+4}\,dz$ where c is |z- i|= 2	5	3	L3
(b)	Solve $\int_c Re(z)dz$ where c is a straight line from 0 to (1+2i)	4	3	L3
MODULE-4				
13(a)	Expand f(z)= $\frac{z+1}{z-1}$ as a Taylor series about z= -1	5	4	L3
(b)	Find poles and residue of f(z)= $\frac{ze^{2iz}}{z^2+9}$	4	4	L2
OR				
14(a)	Solve $\int_c \frac{\sin\pi z^2+\cos\pi z^2}{(z-1)(z-2)}\,dz$ where c is |z|=3	5	4	L3
(b)	Expand f(z)= $\frac{1}{z^2}$ as Taylor series about z= 2	4	4	L2

25UMET301	STRENGTH OF MATERIALS	Category	L	T	P	R	Credit	Year of Introduction
		PCC	3	1	0	0	4	2025

Preamble: This course provides a comprehensive introduction to the mechanics of deformable solids, focusing on the analysis of stress, strain, and deformation under various loading conditions. It systematically develops the theoretical foundations of axial loading, torsion, bending, pressure vessels, and column stability, along with stress transformation and energy methods.

Prerequisite: EMS103 Engineering Mechanics

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Apply fundamental concepts of stress and strain to determine stress–strain behavior of linearly elastic materials under simple loading conditions.	**K3 Apply**
CO2	Analyze axial deformation of prismatic and composite members including thermal effects and strain energy, and determine principal stresses.	**K4 Analyze**
CO3	Apply the theory of simple bending and torsion to determine bending stresses, torsional stresses, shear force and bending moment distributions in beams and circular shafts.	**K3 Apply**
CO4	Explain the concepts of beam deflection, column buckling, and classical theories of failure to interpret stability and failure behavior of structural members.	**K2 Understand**

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	2	-	-	-	-	-	-	-	-	2	2
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3
CO4	3	3	3	2	2	-	-	-	-	-	-	2	3
Avg	3	3	2.5	2	2	-	-	-	-	-	-	2	2.75

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	-	-	-	-	-
CO2	*	*	*	*	*	-	-	-	-
CO3	*	*	*	*	*	-	-	-	-
CO4	*	*	*	*	*	-	-	-	-

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	-	-	-	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (12 hrs)

Introduction to mechanics of deformable bodies and concept of continuum. Internal forces and stress at a point. Normal stress and shear stress. Concept of strain: normal strain and shear strain. Linear strain and lateral strain. Poisson's ratio. Volumetric strain.

Constitutive relations for linear elastic materials. Hooke's law in one dimension. Stress–strain diagram for ductile and brittle materials. Elastic constants: modulus of elasticity, modulus of rigidity and bulk modulus. Relationship among elastic constants. Saint-Venant's principle.

Module 2 (14 hrs)

Axial deformation of prismatic bars subjected to direct load. Deformation of members with varying cross section. Principle of superposition. Statically determinate composite bars under axial loading.

Thermal stresses in simple and composite members.

Strain energy due to axial loading. Gradually applied load, suddenly applied load and impact load. Generalized Hooke's law for isotropic materials (introductory form). Two-dimensional stress transformation equations. Principal stresses and principal planes. Mohr's circle for plane stress.

Module 3 (15 hrs)

Theory of simple bending and its assumptions. Flexural stress distribution in rectangular, circular and I-sections. Section modulus.

Torsion of solid and hollow circular shafts. Assumptions of torsion theory. Derivation of torsion equation. Polar moment of inertia. Angle of twist. Torsional rigidity.

Beams- Types-Shear force and bending moment diagrams for cantilever, simply supported and overhanging beams subjected to concentrated loads and uniformly distributed loads.

Module 4 (15 hrs)

Load–deflection differential equation of beams. Determination of slope and deflection of simply supported and cantilever beams using Macaulay's method. Buckling of columns. Concept of crippling load. Euler's critical load for different end conditions. Effective length and slenderness ratio.

Maximum principal stress theory (Rankine's theory), Maximum shear stress theory (Guest–Tresca theory), Maximum strain theory (Saint-Venant theory), Maximum strain energy theory, Maximum distortion energy theory (von Mises theory). Comparison and applicability to ductile and brittle materials.

Text Books:

1. Hibbeler, R. C., *Mechanics of materials* (10th ed.). Pearson Education, 2017.
2. Beer, F. P., Johnston, E. R., Jr., DeWolf, J. T., & Mazurek, D. F., *Mechanics of materials* (7th ed.). McGraw Hill Education, 2014.
3. Bhavikatti, S. S., *Strength of materials* (3rd ed.). V. G. Gadag & Co., 2010.
4. Bansal, R. K., *Strength of materials* (6th ed.). Laxmi Publications, 2010.

Reference Books:

1. Popov, E. P., *Engineering mechanics of solids* (2nd ed.). Prentice Hall of India, 2002.
2. Gere, J. M., & Goodno, B. J., *Mechanics of materials* (8th ed.). Cengage Learning, 2012.
3. Timoshenko, S. P., & Young, D. H., *Elements of strength of materials* (5th ed.). CBS Publishers, 2011.
4. Srinath, L. S., *Advanced mechanics of solids* (1st ed.). Tata McGraw Hill Education, 2010.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	**25UMET301**
Course Name	**Strength of Materials**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1	Explain the significance of Poisson's ratio and derive the expression for volumetric strain in terms of linear strain.	3	1	L2
2	Describe Saint-Venant's principle and discuss its importance in stress analysis.	3	1	L2
3	Explain the principle of superposition and state the conditions under which it is applicable in axial deformation problems.	3	2	L2
4	Define principal stresses and principal planes. Explain their engineering significance.	3	2	L2
5	State the assumptions of simple bending theory and explain the concept of section modulus.	3	3	L2
6	Explain the assumptions made in the theory of torsion of circular shafts.	3	3	L2
7	Define crippling load, effective length, and slenderness ratio for columns.	3	4	L2
8	Compare Maximum Principal Stress Theory and Maximum Shear Stress Theory of failure.	3	4	L2

Part B (*Answer any one full question from each Module. Each carry 9 marks*)				
Module I				
Qn No.	**Question**	**Marks**	**CO**	**BL**
9	A steel rod of 30 mm diameter and 2 m length is subjected to a tensile load of 120 kN. Determine the stress, strain and elongation if E = 200 GPa. Also calculate the lateral contraction assuming Poisson's ratio = 0.3.	9	1	L3
OR				
10	A cylindrical specimen is subjected to a tensile force of 90 kN. Given its original diameter is 25 mm and gauge length is 300 mm, determine the stress, strain and extension if E = 210 GPa. Verify the applicability of Hooke's law for the given loading condition.	9	1	L3

Module II				
Qn No.	**Question**	**Marks**	**CO**	**BL**
11	A composite bar consisting of steel and aluminium sections is subjected to an axial load of 120 kN. Determine the stresses developed in each material and the total deformation. Analyse the effect of compatibility of deformation in obtaining the solution.	9	2	L4
OR				
12	At a point in a stressed member, $\sigma_x = 80MPa$ (tensile), $\sigma_y = -20MPa$ (compressive), and τxy = 40 MPa. Analyse the state of stress by determining the principal stresses, principal planes and maximum shear stress using Mohr's circle.	9	2	L4
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13.	A simply supported beam of span 6 m carries a point load of 20 kN at its centre. Draw the shear force and bending moment diagrams and determine the maximum bending moment.	5	3	L3
OR				
14.	A hollow circular shaft transmits 250 kW at 150 rpm. The outside diameter is 200 mm and the inside diameter is 120 mm. Determine the maximum shear stress and angle of twist over a length of 4 m if G = 80 GPa.	5	3	L3
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.	Explain Euler's theory of column buckling and discuss the effect of different end conditions on the critical load.	6	4	L2
OR				
16.	Explain the Maximum Distortion Energy Theory (von Mises theory) and compare it with the Maximum Principal Stress Theory with suitable applications to ductile and brittle materials.	6	4	L2

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25UMET302	FLUID MECHANICS AND HYDRAULIC MACHINES	Category	L	T	P	R	Credit	Year of Introduction
		PCC	3	1	0	0	4	2025

Preamble: This course introduces the fundamental principles of fluid mechanics and their simple engineering applications. It also familiarizes students with the working principles and relevance of turbomachines, enabling them to analyze and solve basic engineering problems related to fluid flow and energy conversion.

Prerequisite: ICM104 Introduction to Mechanical Engineering & Civil Engineering

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Apply fundamental fluid properties and fluid statics principles to determine pressure forces, buoyancy and stability	K3 Apply
CO2	Apply principles of fluid kinematics and basic fluid dynamics to analyse fluid flow and flow measurement devices.	K3 Apply
CO3	Analyse internal pipe flow problems, estimate energy losses and apply dimensional analysis and boundary layer concepts.	K4 Analyse
CO4	Explain and apply the working principles and performance parameters of hydraulic turbines and pumps for engineering applications.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	-	2	-	-	-	-	-	1	2	1
CO2	3	3	1	2	2	-	-	-	-	-	1	2	2
CO3	2	2	3	1	2	-	-	-	-	-	1	3	3
CO4	2	2	3	1	2	-	-	-	-	-	1	3	3
Avg	2.5	1.75	2.33	1.33	2	-	-	-	-	-	1	2.5	2.25

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	*	-	-	-
CO2	*	*	*	*	*	*	*	-	-
CO3	*	*	*	*	*	*	*	*	-
CO4	*	*	*	*	*	*	*	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment /IV report : 15 marks

SYLLABUS

Module 1 (12 hrs)

Properties of fluids: density, specific weight, specific gravity, specific volume. Dynamic and kinematic viscosity, Newton's law of viscosity (applications only). Compressibility and bulk modulus. Surface tension and capillarity. Introduction to fluid mechanics: scope and continuum concept. Pressure concepts: atmospheric, gauge and absolute pressure. Pressure head and measurement using piezometer, simple and differential manometers (basic numericals). Mechanical and electronic pressure measurement device.Fluid statics: pressure–depth relationship. Hydrostatic force on plane and inclined surfaces, centre of pressure (standard problems). Buoyancy and metacentre: stability of immersed and floating bodies (conceptual + simple problems). Stability of floating bodies in practical applications (ships, floating structures).

Module 2 (14 hrs)

Description of fluid motion: Eulerian and Lagrangian approach. Types of flow. Velocity and acceleration in fluid flow (basic expressions). Streamlines, pathlines and streaklines. Stream function and velocity potential (conceptual treatment). Flow net (applications only). Introduction to circulation and vorticity.

Continuity equation (1D incompressible flow), Bernoulli's equation – assumptions, applications and limitations. Extended Bernoulli equation with head loss. Euler's equation (concept only). Flow measurement: Pitot tube, Venturimeter and Orificemeter (moderate numericals). Rectangular and triangular notches (working principle only). Rotameter and electromagnetic flow meter.

Module 3 (14 hrs)

Laminar and turbulent flow. Reynolds number and significance. Velocity distribution and shear stress in laminar pipe flow. Hagen–Poiseuille equation (applications). Major and minor losses in pipes. Darcy–Weisbach equation and Chezy's equation. Moody's chart – interpretation and use. Hydraulic Gradient Line (HGL) and Total Energy Line (TEL). Pipes in series and parallel. Navier–Stokes equation – physical meaning (no derivation). Dimensional analysis: Buckingham's π theorem (procedure + simple examples). Model analysis and similitude. Boundary layer concept: laminar and turbulent boundary layer. Boundary layer separation (qualitative treatment). Methods of controlling separation.

Module 4 (16 hrs)

Impact of jets on fixed and moving flat plates and curved vanes. Velocity triangles (basic construction only). Applications in impulse turbines. Hydraulic turbines: classification and comparison. Pelton, Francis and Kaplan turbines – working, components, efficiencies (no velocity-triangle numericals). Performance characteristics and selection criteria. Centrifugal pump – construction, working, head, efficiencies, priming and cavitation. Reciprocating pump – working, slip, negative slip and efficiency (simple numericals). Performance characteristics and pump selection. Air vessels and their function.

<u>Students should undergo a related Field/Industrial Visit as part of the course.</u>

Text Books:

1. Çengel, Y. A., & Cimbala, J. M., *Fluid mechanics*. Tata McGraw Hill, 2013.
2. Bansal, R. K., *Fluid mechanics and hydraulic machines*. Laxmi Publications, 2005.
3. Som, S. K., *Introduction to fluid mechanics and fluid machines*. McGraw Hill Education India, 2011.

Reference Books:

1. White, F. M., *Fluid mechanics*. Tata McGraw Hill, 2003.
2. Fisher, & Henly, *Engineering applications of fluid dynamics*. Willford Press, 2023.
3. Rathakrishnan, E., *Fluid mechanics: An introduction* (4th ed.). Prentice Hall India, 2022.
4. Modi, P. N., & Seth, S. M., *Hydraulics and fluid mechanics including hydraulic machines* (23rd ed.), 2022.

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	**25UMET302**	
Course Name	**Fluid Mechanics and Hydraulic Machines**	
Max. Marks: 60		**Duration: 2.5 Hours**

Part A

(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Illustrate how viscosity and surface tension influence fluid flow behaviour in practical engineering applications.	3	CO 1	L3
2	Apply the principle of buoyancy to explain the concept of metacentric height and its role in the stability of floating bodies.	3	CO 1	L3
3	Illustrate the application of Bernoulli's equation by explaining the assumptions on which it is based.	3	CO 2	L3
4	Illustrate the differences between a Venturimeter and an Orificemeter with respect to their performance and practical applications.	3	CO 2	L3
5	Analyze the role of the Reynolds number in predicting the nature of flow and its influence on pipe flow behavior.	3	CO 3	L4
6	Examine the Hydraulic Gradient Line (HGL) and the Total Energy Line (TEL), and analyze their roles in representing energy distribution in pipe flow.	3	CO 3	L4
7	Apply the concept of flow direction to classify hydraulic turbines and explain the features of each classification.	3	CO 4	L3
8	Illustrate the purpose of priming and explain why it is essential for the efficient operation of centrifugal pumps.	3	CO 4	L3

Part B

(*Answer any one full question from each Module. Each carry 9 marks*)

Module I

Qn No.	Question	Marks	CO	BL
9.a)	Apply the principles of simple and differential manometers to explain pressure measurement, with the help of neat sketches.	5	CO 1	L3
9.b)	Apply the principles of fluid statics to determine the hydrostatic force acting on a vertical plane surface.	4	CO 1	L3
	OR			
10.a)	Illustrate the concepts of buoyancy and stability of floating bodies using neat diagrams and explain their applications.	5	CO 1	L3
10.b)	Apply the concept of metacentric height to assess the stability of a floating body.	4	CO 1	L3

Module II				
Qn No.	**Question**	**Marks**	**CO**	**BL**
11.a)	Apply Bernoulli's equation to determine the discharge through a Venturimeter.	5	CO 2	L3
11.b)	Compare the Eulerian and Lagrangian approaches used to describe fluid motion and explain their engineering applications.	4	CO2	L3
OR				
12.a)	Apply the continuity equation to solve one-dimensional incompressible fluid flow problems.	5	CO 2	L3
12.b)	Illustrate the construction of a Pitot tube and explain its working for velocity measurement using a neat sketch.	4	CO2	L3
Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13. a	Analyse the major and minor losses occurring in pipe flow and explain the factors affecting them.	5	CO 3	L4
13. b	Examine the concept of the boundary layer and analyze the factors responsible for boundary layer separation.	4	CO 3	L4
OR				
14. a	Analyse the flow through pipes connected in series and parallel to estimate the discharge and head loss.	5	CO 3	L4
14. b	Deconstruct a dimensional analysis problem and establish the governing dimensionless groups using Buckingham's π theorem.	4	CO 3	L4
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15. a	Relate the construction and working of a centrifugal pump to its performance characteristics.	6	CO 4	L3
15. b	Apply the performance characteristics of hydraulic turbines to select a suitable turbine for a given hydraulic head and discharge.	3	CO 4	L3
OR				
16. a	Relate the construction of Pelton, Francis, and Kaplan turbines to their working principles using neat sketches.	6	CO 4	L3
16. b	Apply the concept of impact of jet on curved vanes to determine the force exerted by the jet.	3	CO 4	L3

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25UMET303	PRINCIPLES OF MANUFACTURING	Category	L	T	P	R	Credit	Year of Introduction
		PBL	3	0	0	1	**4**	**2025**

Preamble: The objective of this course is to provide students with a comprehensive understanding of the fundamental principles and processes involved in manufacturing. It introduces the concepts of casting, metal forming, joining processes, powder metallurgy, sheet metal operations, and additive manufacturing.

Prerequisite: Nil

Course Outcomes:

CO	Course Outcomes	Knowledge Level
CO1	Explain the principles of casting, metal forming, joining, powder metallurgy, and additive manufacturing processes.	K2 Understand
CO2	Apply manufacturing process principles to select suitable casting, forming, joining, and additive manufacturing methods for engineering components.	K3 Apply
CO3	Apply manufacturing concepts to identify defects, analyze failures, and recommend process improvements in engineering products.	K3 Apply
CO4	Demonstrate reverse engineering, process mapping, and manufacturing documentation to solve real-world manufacturing problems.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	1	1	–	1	–	–	–	–	2	1
CO2	3	3	3	2	2	–	1	–	–	1	–	3	2
CO3	3	3	3	3	2	1	2	–	2	2	–	3	3
CO4	2	2	3	3	3	1	2	–	3	3	–	3	3
Avg	2.75	2.5	2.5	2.25	2.0	1.0	1.5	–	2.5	2.0	–	2.75	2.25

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	–	–	*	–
CO2	*	*	*	*	*	*	–	*	–
CO3	*	*	*	*	*	*	–	*	–
CO4	*	*	*	*	*	*	*	*	–

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	**60**	**40**	**2.5 hrs**

Continuous Internal Evaluation Pattern:

Attendance : 5 marks

Continuous Assessment Test : 25 marks

Experiential Evaluation : 30 marks

SYLLABUS

Module 1 (14 hrs)

Introduction to casting, Patterns: Types and Materials-Types of Allowances; Moulding sand – gating system design, riser design; special casting process - Die casting, Precision Investment casting, Centrifugal casting, Continuous casting and Squeeze casting; defects in castings.

Plastic deformation of metals, stress-strain relationships, Yield criteria. Introduction to hot and cold working.

Module 2 (14 hrs)

Forging: Open die forging and closed die forging, Various Forging Operations, Forging machines, Forging defects – Residual stresses in forging

Rolling: Various Rolling Processes and Mills, rolling force and power, numerical problems, Defects in rolled product.

Extrusion: Hot and Cold extrusion; Extrusion equipment's; Defects in extrusion; Hydrostatic extrusion; Extrusion of tubes & seamless pipes

Drawing: Drawing process; Drawing forces, Die design and die materials; Drawing defects and residual stresses; Drawing equipment.

Module 3 (14 hrs)

Metal Joining: Classifications of Welding Processes.

Gas welding; Oxyfuel-gas Welding, Flame types and filler metals, Applications

Arc welding: Non-consumable Electrode Arc Welding processes - Gas Tungsten-arc

Welding, Plasma-arc Welding; Consumable Electrode Arc Welding processes: Shielded Metal-arc Welding, Submerged-arc Welding, Gas Metal-arc Welding, Flux-cored Arc Welding.

Electron beam Welding and Laser beam welding

Solid-State Welding Processes: Ultrasonic Welding, Friction Welding, Thermit Welding, Resistance welding.

Solidification of the Weld Metal and Heat Affected Zone, Residual Stresses, Weldability of ferrous and non-ferrous metals, Defects in welding.

Brazing - soldering - adhesive bonding

Module 4 (14 hrs)

Powder Metallurgy: Methods of Powder Production, Blending Metal Powders, Compaction of Metal Powders, Sintering, Secondary and Finishing Operations

Sheet metal operations: Shearing operations – punching and blanking, Type of Shearing Dies, Clearance and Punch and Die Shape of shearing dies.

Bending: Bending of Sheets, Plates, and Tubes, Minimum Bend Radius, Springback, Bending force.

Additive Manufacturing: Classification of AM technologies, Fused deposition Modelling (FDM), Laminated Object Manufacturing (LOM), Selective Laser Sintering (SLS) and Laser Engineered Net Shaping (LENS)

Text Books:

1. Kalpakjian, S., & Schmid, S. R., *Manufacturing engineering and technology* (6th ed.). Prentice Hall, 2009.
2. Jain, R. K., *Production technology* (17th ed.). Khanna Publishers, 2001.
3. Gibson, I., Rosen, D., Stucker, B., & Khorasani, M., *Additive manufacturing technologies* (3rd ed.). Springer, 2021.
4. American Welding Society, *Welding handbook: Welding science and technology* (Vol. 1, 9th ed.). American Welding Society, 2001.

Reference Books:

1. Beddoes, J., & Bibby, M. J., *Principles of metal manufacturing processes.* Elsevier, 2003.
2. *The Welding Institute of Metals, Metals handbook* (Vol. 5). The Welding Institute of Metals, 1977.
3. Heine, R., Loper, C., & Rosenthal, P., *Principles of metal casting*. Tata McGraw Hill, 2004.
4. Flemings, M. C., *Solidification processes*. McGraw Hill, 1974.

Project/Experiential Evaluation (30 marks)

1. **The Field Audit & Problem Identification (10 Marks) – Team Activity (group of 3-4)**

   Task: Each student must visit a local industry (e.g., local workshop / fabrication unit / foundry / sheet metal shop / welding shop) in their vicinity.

   They must identify a specific manufacturing defect or inefficiency related to the syllabus (e.g., casting defects in a local foundry, improper welding in a gate, springback issues in a bending shop, or a forging crack in a hand tool).

   Deliverables:

   Technical Diagnosis Report

   3-minute video documentation

   Evaluation Rubrics (10 marks)

Criteria	Marks
Technical Understanding	3
Defect Analysis	3
Practical Insight	2
Presentation quality	2

2. **Reverse Engineering & Process Mapping Challenge**

   Task: Teams need to select a common household or industrial object (e.g. a wrench, a soda can, Bicycle rim, Spanner, Welded chair, 3D printed part).

   They must "deconstruct" the manufacturing history. They will create a Process Flow Map identifying whether it was forged, rolled, or extruded, and why that specific method was chosen over others.

   Deliverables:

   Technical Report including product photographs, Process Flow Map (hand-drawn or software-generated) and Process selection justification

   Evaluation Rubrics (10 marks)

Criteria	Marks
Correct process identification	3
Flow clarity	3
Process reasoning	2
Technical report	2

3. **Manufacturing Failure Analysis & Public Awareness Project**

   Task: Students investigate a real-life product failure from society and analyze it using manufacturing principles learned in the course.

   Each group must select a failed or defective product from real life:

   Examples:

- Cracked welded gate
- Broken forged spanner
- Bent sheet metal roofing
- Leaking cast pump housing
- Failed bicycle rim
- Cracked aluminum utensil
- Worn-out powder metallurgy bush
- 3D printed component failure

Students must do the following activities

Identify

- Manufacturing process used
- Material involved
- Type of failure (fracture, porosity, distortion, residual stress, etc.)

Diagnose

- Root cause of failure
- Link to theory (gating defect, improper rolling, weld HAZ issue, springback, etc.)

Recommend

- Process improvement
- Design modification
- Alternative manufacturing method
- Sustainability consideration

Public awareness output

Students must prepare:

- A 1-page illustrated awareness poster and
- A 2-minute awareness video explaining:
  "Why this failure happened and how to prevent it."

The awareness poster or video can be exhibited to non-department students during college exhibitions, shared with workshop owners or local technicians for practical feedback, and presented as part of NSS or community engagement activities to create public awareness about manufacturing quality and failure prevention etc.

Evaluation Rubric (10 Marks)

Criteria	Marks
Correct process identification	2
Root cause technical analysis	2
Link to manufacturing theory	2

Improvement suggestion quality	2
Awareness material quality	2

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code	**25UMET303**
Course Name	**PRINCIPLES OF MANUFACTURING**
Max. Marks: 40	**Duration: 2.5 Hours**

Part A (Answer all questions. Each question carries 2 marks)				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1	Explain the various types of pattern allowances provided in casting process.	2	CO 1	L2
2	Explain the working principle of centrifugal casting process.	2	CO 1	L2
3	Explain the different types of rolling mills used in metal forming operations.	2	CO 2	L2
4	Describe the various defects that occur in extrusion process.	2	CO 2	L2
5	Explain the working principle of Gas Tungsten-Arc Welding process with a neat sketch.	2	CO 3	L2
6	Describe the process of brazing and differentiate it from soldering.	2	CO 3	L2
7	Explain the various steps involved in the powder metallurgy process.	2	CO 4	L2
8	Describe the working principle of Fused Deposition Modelling process.	2	CO 4	L2
Part B (Answer any one full question from each Module. Each carries 6 marks)				
Module I				
Qn No.	**Question**	**Marks**	**CO**	**BL**
9	Explain the design considerations for gating system and riser design in a casting process, with the help of neat sketches.	6	CO 1	L2
OR				

10	Discuss the plastic deformation behaviour of metals and explain the yield criteria along with the stress-strain relationship.	6	CO 1	L2
	Module II			
Qn No.	**Question**	**Marks**	**CO**	**BL**
11	A steel strip of initial thickness 25 mm is to be rolled to a final thickness of 20 mm using rolls of diameter 500 mm. Apply the principles of rolling to calculate the rolling force required, given that the average flow stress of the material is 240 MPa and the width of the strip is 300 mm. Also discuss the defects observed in rolled products.	6	CO 2	L3
	OR			
12	Apply the concept of extrusion to explain the die design considerations for tube extrusion, and calculate the extrusion force required for a billet of diameter 100 mm being extruded through a die of diameter 50 mm, given the flow stress of the material as 300 MPa.	6	CO 2	L3
	Module III			
Qn No.	**Question**	**Marks**	**CO**	**BL**
13	Apply the principles of arc welding to select a suitable welding process for joining two austenitic stainless steel plates of 10 mm thickness, justifying your choice based on weldability and heat-affected zone considerations.	6	CO 3	L3
	OR			
14	Demonstrate, with suitable sketches, how residual stresses develop during solidification of the weld metal, and apply this understanding to suggest suitable methods to minimize distortion in welded structures.	6	CO 3	L3
	Module IV			
Qn No.	**Question**	**Marks**	**CO**	**BL**
15	A circular blank of diameter 40 mm is to be punched from a sheet metal of thickness 2 mm having shear strength 350 MPa. Calculate the punching force required, and apply the concept of clearance to determine the clearance to be provided between the punch and die.	6	CO 4	L3
	OR			
16	Apply the concept of bending to calculate the minimum bend radius and springback for a sheet metal of thickness 3 mm, yield strength 250 MPa and modulus of elasticity 200 GPa, given that the bend angle is 90°.	6	CO 4	L3

25UAMT304	FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE	Category	L	T	P	R	Credit	Year of Introduction
		ESC	3	1	0	0	**4**	**2025**

Preamble: Artificial Intelligence (AI) and Data Science are transformative technologies that are reshaping industries, economies, and everyday life across the globe. From intelligent virtual assistants and recommendation systems to autonomous vehicles and predictive healthcare analytics, AI and Data Science are driving innovation and enabling data-driven decision-making in unprecedented ways. The course provide students with a foundational understanding of the principles, methodologies, and applications of intelligent systems and data analytics.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Explain the concept of machine learning including neural networks and different learning techniques for engineering applications.	K2 Understand
CO2	Apply mathematical concepts such as matrix operations, probability And regression to solve engineering problems.	K3 Apply
CO3	Demonstrate knowledge of essential skills and tools required for Data Science, including data storage techniques and dataset creation.	K3 Apply
CO4	Apply appropriate data pre-processing techniques to prepare datasets for analysis and modeling.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	2	2	-	-	-	-	-	-	-	-	2	2
CO2	2	2	2	-	-	-	-	-	-	-	-	2	2
CO3	2	3	3	2	-	-	-	-	-	-	-	3	2
CO4	3	3	3	2	-	-	-	-	-	-	-	3	3
Avg	2.2	2.5	2.5	2	-	-	-	-	-	-	-	2.5	2.2

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*				
CO2	*	*	*	*					
CO3		*	*	*	*				
CO4	*	*		*	*				

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*				

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (14 hrs)

Basics of Machine Learning -types of Machine Learning systems-challenges in ML- Supervised learning model example- regression models- Classification model example- Logistic regression-unsupervised model example- K-means clustering. Artificial Neural Network- Perceptron-Universal Approximation Theorem.

Module 2 (14 hrs)

Role of linear algebra in Data representation and analysis – Matrix decomposition- Singular Value Decomposition (SVD)- Spectral decomposition. Basics of probability-random variables and statistical measures - rules in probability-Bayes theorem and its applications-Correlation analysis-linear correlation - regression analysis- linear regression.

Module 3 (14 hrs)

Data Science: Steps in doing Data Science - Data Science relation to other fields- Data Science and Information Science- Computational Thinking - Skills and tools needed to do Data Science - Storing data - Combining bytes into larger structures - Creating data sets - Identifying data problem - Understanding data sources - Exploring data models- Introduction to Big Data.

Module 4 (14 hrs)

Structured and unstructured data - Challenges with unstructured data - Data collection: Open data - multimodal data - Data Pre-processing: Data Cleaning - Data Integration, Data Transformation - Data Reduction - Data Discretization. Applications of Machine Learning in Data Science- modelling process- demonstration of ML. Benefits of data science-use of statistics and Machine Learning in Data Science- data science process applications in data science.

Text Books:

1. Gilbert Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press, 6th edition, 2023.
2. Gupta.S.C and V.K.Kapoor, Fundamentals of mathematical statistics, Sultan Chand & Sons ,9th edition,2020
3. Cielen, Davy and Arno Meysman, Introducing data science: bigdata, machine learning, and more, using Python tools, Simon and Schuster, 1st edition, 2016

Reference Books:

1. Avrim Blum, John Hopcroft, and Ravi Kannan , Foundations of Data Science, Cambridge University Press, 1st edition, 2020
2. Carlos Fernandez, Probability and Statistics for Data Science , Center for Data Science in NYU, 1st edition, 2017
3. Kotu Vijay, and Bala Deshpande ,Data science: concepts and practice, Morgan 2nd edition, 2018

END SEMESTER EXAMINATION – MODEL QUESTION PAPER

Course Code: 25UAMT304	**Course Name: Fundamentals of Artificial Intelligence & Data Science**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A (Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Define machine learning and explain the difference between supervised and unsupervised learning with suitable examples.	3	CO1	L2
2	Explain the concept of Logistic Regression and state how it differs from Linear Regression.	3	CO1	L2
3	Define Singular Value Decomposition (SVD) and state its significance in data representation.	3	CO2	L2
4	State Bayes' theorem and explain its role in probability-based classification.	3	CO2	L2
5	List the essential skills and tools required to perform Data Science and explain any two in brief.	3	CO3	L2
6	Explain the concept of Computational Thinking and its relevance to Data Science.	3	CO3	L2
7	Define data pre-processing and explain the need for data cleaning in the data analysis pipeline.	3	CO4	L2
8	Distinguish between structured and unstructured data with suitable examples.	3	CO4	L2

Part B (Answer any one full question from each Module. Each carries 9 marks)

Module I

Qn No.	Question	Marks	CO	BL
9	Explain the different types of Machine Learning systems in detail. Discuss the challenges involved in Machine Learning and illustrate how a supervised learning regression model works with an example.	9	CO1	L2

OR				
10	Describe the architecture and working principle of an Artificial Neural Network. Explain the Perceptron model and state the Universal Approximation Theorem with its significance in neural network design.	9	CO1	L2

Module II				
Qn No.	**Question**	**Marks**	**CO**	**BL**
11	A retail company has collected customer data represented as a matrix A consisting of 4 customers (rows) and 3 features: monthly spend, number of visits, and loyalty score (columns). The company wants to reduce the dimensionality of this data for visualization while preserving maximum variance. (a) Explain how Singular Value Decomposition (SVD) of matrix A can be used to achieve this dimensionality reduction. Outline the steps involved, including how the singular values indicate which components to retain. (b) A discrete random variable X represents the number of visits per month by a customer, with the following probability distribution: X = 1, 2, 3, 4 with P(X) = 0.1, 0.3, 0.4, 0.2 respectively. Calculate the mean (expected value) and variance of X, and interpret what these values tell the company about customer visiting behaviour.	9	CO2	L2
OR				
12	A medical testing centre uses a screening test for a disease that is present in 2% of the population. The test correctly identifies the disease in 95% of people who actually have it (true positive rate), and incorrectly indicates the disease in 4% of people who do not have it (false positive rate). A randomly selected person tests positive. (a) Apply Bayes' theorem to calculate the probability that this person actually has the disease. Comment on what this result implies about the reliability of the test in practice. (b) The centre also recorded the age (X, in years) and blood pressure (Y, in mmHg) of 6 patients: X: 25, 32, 40, 48, 55, 60 Y: 118, 122, 130, 138, 145, 150 Calculate Pearson's correlation coefficient between age and blood pressure, and use simple linear regression to predict the blood pressure of a 50-year-old patient.	9	CO2	L2

Module III				
Qn No.	**Question**	**Marks**	**CO**	**BL**
13.a	A retail startup wants to build a system that predicts which products a customer will buy next, using past purchase records, website browsing logs, and social	5	CO3	L3

	media reviews. Apply the steps involved in doing Data Science to outline how the team should proceed from problem identification to deployment, and justify how this process relates Data Science to other fields such as Information Science.			
13.b	A hospital wants to create a single dataset by combining numeric patient vitals, text-based doctor's notes, and X-ray images for analysis. Apply appropriate data storage techniques to combine these different types of bytes into larger structures, and identify the skills and tools the data science team would need to create this dataset.	4	CO3	L3
OR				
14.a	A telecom company is experiencing high customer churn but does not know the underlying cause. Apply the process of identifying the data problem and understanding the relevant data sources, such as call records, billing history, and complaint logs, that the company should investigate. Demonstrate with a suitable example how exploring different data models could help uncover patterns behind the churn.	5	CO3	L3
14.b	A social media platform generates millions of posts every day and wants to identify trending topics in real time. Apply the concept of Computational Thinking to decompose this problem into manageable parts, and demonstrate the skills and tools needed to handle the Big Data characteristics, namely volume, velocity, and variety, involved in solving it.	4	CO3	L3
Module IV				
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.a	Apply data pre-processing techniques—including Data Cleaning, Data Integration, Data Transformation, and Data Reduction—to prepare a given dataset for machine learning modeling. Explain Data Discretization with examples.	6	CO4	L3
15.b	Analyse how Machine Learning is applied in Data Science by describing the modelling process and the benefits of using statistics and Machine Learning in Data Science applications.	3	CO4	L3
OR				
16.a	Analyse the challenges involved in handling unstructured data. with the methods of data collection including open data and multimodal data, and apply appropriate pre-processing strategies for such data.	6	CO4	L3
16.b	Apply the data science process with real-world applications. Demonstrate how the use of statistics and	3	CO4	L3

	Machine Learning contributes to data science process outcomes.			

25UHUT002	**SUSTAINABILITY AND ETHICS IN ENGINEERING**	Category	L	T	P	R	**Credit**	**Year of Introduction**
		HMC	2	0	0	0	**2**	**2025**

Preamble: This course is designed to cultivate a holistic perspective in engineering students by integrating professional integrity**,** social equity**,** and environmental stewardship. In an era of rapid technological advancement and climate volatility, technical expertise alone is insufficient; the modern engineer must be a morally conscious decision-maker.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	**Course Outcomes**	**Knowledge Level**
CO1	Explain fundamental ethical theories to resolve moral dilemmas in personal and professional contexts.	K2 Understand
CO2	Outline philosophical perspectives of environmental ethics to protect biodiversity and manage urban environmental impacts.	K2 Understand
CO3	Develop strategies for Zero Waste and Circular Economy to mitigate disruptions in the hydrological cycle and resource depletion.	K3 Apply
CO4	Illustrate the importance of Renewable Energy technologies in combating the climate crisis in relation to Environmental Regulations and the Sustainable Development Goals (SDGs)**.**	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**
CO1	-	-	-	-	-	2	-	3	2	2	-
CO2	-	-	-	-	-	3	-	2	3	2	-
CO3	1	1	2	-	-	2	3	-	-	-	-
CO4	2	2	3	2	2	2	3	1	-	2	2
Avg	**1.5**	**1.5**	**2.5**	**2**	**2**	**2.25**	**3**	**2**	**2.5**	**2**	**2**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	-	-	-	*		*	-	-
CO2	*	-	-	-	*		*	-	-
CO3	*	*	*	*	*		*	-	*
CO4	*	*	*	*	*	*	*	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	40	60	2.5 hrs

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (7 hrs)

Fundamentals of ethics -Moral Relativism vs. Objectivity. Consequentialism. Deontology Metaethics. Personal vs. professional ethics, Civic Virtue, Respect for others, Profession and Professionalism, Plagiarism, case studies, Technology and digital revolution, Cybertrust and cybersecurity, High technologies: connecting people and places- Managing conflict, Confidentiality, Codes of Ethics. Basic concepts in Gender Studies, gender, gender spectrum: gender stereotypes, Gender disparity and discrimination in education, Ethical values and practices in connection with gender Gender policy and women/transgender empowerment initiatives.

Module 2 (7 hrs)

Introduction to Environmental Ethics: key philosophical theories (anthropocentrism, biocentrism, ecocentrism).Deep Ecology.Intrinsic value.Sustainable Engineering Principles: Definition and scope, triple bottom line, life cycle analysis and sustainability metrics. Ecosystems and Biodiversity: An overview of various ecosystems in Kerala/India, and its significance. Landscape and Urban Ecology: Principles of landscape ecology, Urbanization and its environmental impact, Moral Extensionism

Module 3 (7 hrs)

Hydrology and Water Management: water cycle, Environmental flow, disruptions and disasters. Zero Waste Concepts and Practices: Definition of zero waste and its principles, Strategies for waste reduction, Case studies of successful zero waste initiatives. Circular Economy and Degrowth: Differences between linear and circular economies, AI-Driven Energy Optimization, Digital Twins, Bio-Engineering & Biomimicry, Carbon Capture and Storage (CCS), Mobility and Sustainable Transportation: Basic tenets of a Sustainable Transportation design, Integrated mobility systems, E-Mobility.

Module 4 (7 hrs)

Renewable Energy and Sustainable Technologies: (solar, wind, hydro, biomass), Challenges and opportunities in renewable energy adoption. Climate Change and Engineering Solutions: Kerala/India and the Climate crisis, Engineering solutions to mitigate, adapt and build resilience to climate change. Environmental Policies and Regulations: Ethical considerations in environmental policy-making. Case Studies and Future Directions: Analysis of real-world case studies, Emerging trends and future directions in environmental ethics and sustainability, Discussion on the role of engineers in promoting a sustainable future. The Sustainable Development Goal 17.

Text Books:

1. Whitbeck, C. (2011). Ethics in engineering practice and research (2nd ed.). Cambridge University Press.
2. Oakley, J. (2006). Virtue ethics and professional roles. Cambridge University Press.
3. Bakshi, B. R. (2019). Sustainable engineering: Principles and practice. Cambridge University Press.
4. Martin, M. W., & Schinzinger, R. (2014). Ethics in engineering (4th ed.). Tata McGraw-Hill Education.
5. Ahlawat, A. (2019). Sustainable development goals: Directive principles for sustainable India by 2030. Notion Press.

Reference Books:

1. Parmar, R. K. (2025). Green technology and sustainable development (1st ed.). ISBN-13 publication.
2. Kosanam, N. (2023). Beyond carbon: Responsible ways to restore ecological balance. ISBN-13 publication.

END SEMESTER EXAMINATION - MODEL QUESTION PAPER

Course Code	**25UHUT002**
Course Name	**SUSTAINABILITY AND ETHICS IN ENGINEERING**
Max. Marks: 60	**Duration: 2.5 Hours**

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1.	Differentiate between Moral Relativism and Objectivity in the context of professional decision-making.	3	1	L2
2.	Outline the key differences between personal ethics and professional ethics for a practicing engineer.	3	1	L2
3.	Explain the concept of 'Intrinsic Value' within environmental philosophy frameworks.	3	2	L2
4.	Summarise the three core pillars that constitute the 'Triple Bottom Line' of sustainability	3	2	L2
5.	Describe the engineering definition and operational importance of maintaining 'Environmental Flow' in river systems.	3	3	L2
6.	Differentiate between a Linear Economy and a Circular Economy using a conceptual pipeline breakdown.	3	3	L2
7.	Describe the challenges faced by coastal infrastructure in Kerala due to the ongoing climate crisis.	3	4	L2
8.	Outline the overarching objective of Sustainable Development Goal 17 regarding global partnerships.	3	4	L2
	Part B (*Answer any one full question from each Module. Each carry 9 marks*)			
	Module I			
Qn No.	**Question**	**Marks**	**CO**	**BL**
9	Describe the key principles of Consequentialism and Deontology. Explain their relevance in assessing a workplace confidentiality conflict in engineering practice.	9	1	L2
	OR			

10	Explain the role of gender policies and empowerment initiatives in addressing structural discrimination within educational institutions.	9	1	L2
	Module II			
Qn No.	**Question**	**Marks**	**CO**	**BL**
11	Describe the key environmental philosophical theories of Anthropocentrism, Biocentrism, and Ecocentrism and their influence on modern industrial development policies.	9	2	L2
	OR			
12	Explain the key phases of Life Cycle Analysis (LCA) and the sustainability indicators used to evaluate the environmental performance of engineering products.	9	2	L2
	Module III			
Qn No.	**Question**	**Marks**	**CO**	**BL**
13.a	A town experiences frequent water shortages during summer. Apply the concepts of the water cycle and environmental flow to suggest suitable water management measures.	5	3	L3
13.b	Describe the concept of Carbon Capture and Storage (CCS) as a climate mitigation strategy. .	4	3	L2
	OR			
14.a	A residential colony generates a large amount of household waste. Apply the principles of Zero Waste to recommend two strategies for reducing waste generation.	5	3	L3
14.b	Explain the concept of AI-driven energy optimization and its significance in sustainable development.	4	3	L2
	Module IV			
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.a	A coastal community is vulnerable to sea-level rise and flooding. Apply engineering solutions to improve its climate resilience.	5	4	L3
15.b	Summarize the opportunities and challenges associated with renewable energy adoption in India.	4	4	L2
	OR			
16.a	A proposed industrial project is located near a sensitive ecosystem. Apply environmental policy and ethical principles to identify key considerations before project approval.	5	4	L3
16.b	Explain the importance of emerging sustainable technologies in achieving environmental sustainability.	4	4	L2

25UMEL305	MACHINING & ADDITIVE MANUFACTURING LAB	Category	L	T	P	R	Credit	Year of Introduction
		PCL	0	0	3	0	2	2025

Preamble: This laboratory course provides hands-on training in conventional machining processes including turning, shaping, drilling, milling, and grinding, enabling students to apply machining parameters and evaluate cutting performance. It also develops practical fabrication skills through arc and gas welding operations while emphasizing safety and quality considerations.

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Explain the working principles and operations of machining processes such as turning, shaping, drilling, milling and grinding.	K2 Understand
CO2	Explain welding processes, equipment and process parameters used in arc and gas welding.	K2 Understand
CO3	Apply machining and welding operations to fabricate simple components using conventional manufacturing machines.	K3 Apply
CO4	Apply CAD modelling, slicing and FDM 3D printing techniques to design and manufacture components.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	-	-	1	-	-	-	-	-	-	2	-
CO2	2	1	-	-	1	-	-	-	-	-	-	2	-

CO3	**2**	**2**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**2**
CO4	**2**	**2**	**2**	**-**	**3**	**-**	**-**	**-**	**-**	**-**	**-**	**3**	**3**
Avg	**2**	**1.5**	**2.5**	**-**	**2**	**-**	**-**	**-**	**-**	**-**	**-**	**2.25**	**2.5**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	**WK2**	**WK3**	**WK4**	**WK5**	**WK6**	**WK7**	**WK8**	**WK9**
CO1	*	*	*	*	*	–	–	*	–
CO2	*	*	*	*	*	–	–	*	–
CO3	*	*	*	*	*	*	*	*	–
CO4	*	*	*	*	*	*	*	*	–

WKs Mapped with the course

WK1	**WK2**	**WK3**	**WK4**	**WK5**	**WK6**	**WK7**	**WK8**	**WK9**
*	*	*	*	*	*	*	*	-

SYLLABUS

Sl No.	**Experiments**
1	Exercises on lathe: - Plain and step turning.
2	Exercises on lathe: - Ball & curve, and Taper turning.
3	Exercises on lathe: - Thread cutting.
4	Exercises on lathe: - Measurement of cutting forces in turning Process.
5	Exercises on shaping machine: - flat surfaces.
6	Exercises on shaping machine: - Grooves and key ways.
7	Exercises on drilling machine: - drilling, boring, reaming, taping and counter sinking etc.
8	Exercises on drilling machine: - Measurement of cutting forces in drilling process.
9	Exercises on cylindrical grinding machine: - Grinding of a plain cylindrical surface.
10	Exercises on surface grinding machine: - Grinding of a flat surface.
11	Exercises on tool and cutter grinding machine: - Grinding of a single-point cutting tool.

12	Exercises on milling machine: - Plane and pocket milling operations.
13	Exercises on milling machine: - Spur gear cutting operation.
14	Study of Arc Welding Equipment, Electrodes and Process Parameters for SMAW
15	Study of Oxy-Acetylene Gas Welding Setup and Flame Characteristics
16	Exercises on arc welding: - butt welding and lap welding of M.S. sheets.
17	Exercises on gas welding: - butt welding and lap welding of M.S. sheets.
18	Develop 2D sketches and 3D models, apply geometric and dimensional constraints, assemble multiple parts, and export models to STL format.
19	Slicing of a CAD Model Using Different Techniques and Optimization of Process Parameters
20	Design and Fabrication of Assembled Components with Fits and Tolerances Using FDM 3D Printing Technology

A minimum of 12 sets of experiments are mandatory but experiments mentioned for Additive manufacturing are mandatory.

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)	Internal Examination	Total
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	Conduct of experiment/ Execution of work/ troubleshooting/ Programming	Result with valid inference/ Quality of Output	Viva voce	Record	Total
10	15	10	10	5	50

Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record.

Endorsement by External Examiner: The external examiner shall endorse the record.

Text Books:

1. Kalpakjian, S., & Schmid, S. R., *Manufacturing engineering and technology* (6th ed.). Prentice Hall, 2009.
2. Jain, R. K., *Production technology* (17th ed.). Khanna Publishers, 2001.
3. Gibson, I., Rosen, D., Stucker, B., & Khorasani, M., *Additive manufacturing technologies* (3rd ed.). Springer, 2021.
4. American Welding Society, *Welding handbook: Welding science and technology* (Vol. 1, 9th ed.). American Welding Society, 2001.

Reference Books:

1. Beddoes, J., & Bibby, M. J., *Principles of metal manufacturing processes*. Elsevier, 2003.
2. *The Welding Institute of Metals, Metals handbook* (Vol. 5). The Welding Institute of Metals, 1977.
3. Heine, R., Loper, C., & Rosenthal, P., *Principles of metal casting*. Tata McGraw Hill, 2004.
4. Flemings, M. C., *Solidification processes*. McGraw Hill, 1974.

Continuous Assessment (25 Marks)

1. Preparation and Pre-Lab Work (7 Marks)

Pre-Lab Assignments: Assessment of pre-lab assignments or quizzes that test understanding of the upcoming experiment.

Understanding of Theory: Evaluation based on students' preparation and understanding of the theoretical background related to the experiments.

2. Conduct of Experiments (7 Marks)

Procedure and Execution: Adherence to correct procedures, accurate execution of experiments, and following safety protocols.

Skill Proficiency: Proficiency in handling equipment, accuracy in observations, and troubleshooting skills during the experiments.

Teamwork: Collaboration and participation in group experiments.

3. Lab Reports and Record Keeping (6 Marks)

Quality of Reports: Clarity, completeness and accuracy of lab reports. Proper documentation of experiments, data analysis and conclusions.

Timely Submission: Adhering to deadlines for submitting lab reports/rough record and maintaining a well-organized fair record.

4. Viva Voce (5 Marks)

Oral Examination: Ability to explain the experiment, results and underlying principles during a viva voce session.

Final Marks Averaging: The final marks for preparation, conduct of experiments, viva, and record are the average of all the specified experiments in the syllabus.

Evaluation Pattern for End Semester Examination (50 Marks)

1. Procedure/Preliminary Work (10 Marks)

Procedure Understanding and Description: Clarity in explaining the procedure and understanding each step involved.

Preliminary Work and Planning: Thoroughness in planning and organizing materials/equipment.

2. Conduct of Experiment/Execution of Work/Programming (15 Marks)

Setup and Execution: Proper setup and accurate execution of the experiment or programming task.

3. Result with Valid Inference/Quality of Output (10 Marks)

Accuracy of Results: Precision and correctness of the obtained results.

Analysis and Interpretation: Validity of inferences drawn from the experiment or quality of

program output.

4. Viva Voce (10 Marks)

Ability to explain the experiment, procedure results and answer related questions

Proficiency in answering questions related to theoretical and practical aspects of the subject.

5. Record (5 Marks)

Completeness, clarity, and accuracy of the lab record submitted

25UMEL306	MECHANICAL AND MATERIAL TESTING LAB	Category	L	T	P	Credit	Year of Introduction
		PCL	0	0	3	2	2025

Preamble: The Mechanical and Material Testing Lab provides students with practical exposure to the behavior and properties of engineering materials under various loading conditions. In this lab, fundamental tests such as tensile, compression, hardness, impact, and torsion are conducted to determine mechanical properties like strength, ductility, toughness, and stiffness.

Prerequisite: 25UMEL306 Mechanical and Material Testing Lab

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcome	Knowledge Level
CO1	Determine the tensile, compressive, and shear properties of engineering materials using suitable testing machines and standard procedures.	K3 Apply
CO2	Evaluate the hardness, torsional rigidity, and flexural stiffness of different materials using appropriate experimental methods..	K3 Apply
CO3	Analyse the impact strength, notch toughness, and fracture toughness of materials under different loading conditions.	K4 Analyse
CO4	Interpret experimental observations related to spring stiffness and fatigue behaviour, and present the results using proper calculations, graphs, and technical reporting.	K4 Analyse

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	-	1	1	-	-	-	-	-	-	3	-
CO2	3	2	-	1	1	-	-	-	-	-	-	3	-
CO3	2	3	-	2	1	-	-	-	-	-	-	3	1
CO4	2	3	-	2	1	-	-	-	-	-	-	3	1
Avrg	2.6	2	-	1.5	1	-	-	-	-	-	-	3	1

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9

CO1	*	*	*	*	*	*	*	*	–
CO2	*	*	*	*	*	*	*	*	–
CO3	*	*	*	*	*	*	*	*	–
CO4	*	*	*	*	*	*	*	*	–

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	**50**	**50**	**2.5 hrs**

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 25 marks
Internal Examination : 20 marks

SYLLABUS

Experiments

1. Evaluate the tensile properties of a ductile material such as mild steel or high-strength steel using a Universal Testing Machine (UTM) with an extensometer.
2. Conduct a compression test on a ductile material such as mild steel, tor steel, or high-strength steel using a Universal Testing Machine (UTM) with an extensometer.
3. Determine the tensile properties of cast iron, a brittle material, using a Universal Testing Machine (UTM) with an extensometer.
4. Determine the shear strength of a mild steel rod by conducting a shear test.
5. Determine the Brinell hardness number of the given material using a Brinell hardness testing machine.
6. Evaluate the Vickers hardness value of the given specimen using a Vickers hardness tester.
7. Measure the Rockwell hardness of the given material using a Rockwell hardness testing machine and identify the appropriate hardness scale.
8. Determine the torsional rigidity of mild steel, copper, or brass rods by conducting a torsion test.
9. Evaluate the flexural stiffness or flexural rigidity of mild steel, copper, or brass specimens using a three-point bend test on a Universal Testing Machine (UTM).
10. Determine the impact strength of the given material at room temperature using the Izod impact test.

11. Evaluate the notch toughness of the given material at room temperature using the Charpy impact test.
12. Investigate the effect of coil type, close-coiled and open-coiled, on spring stiffness.
13. Study the effect of spring arrangement, series and parallel, on the overall stiffness of a spring system.
14. Evaluate the fracture toughness of a given material using a Universal Testing Machine (UTM).
15. Study the procedure for plotting the S–N curve using a fatigue testing machine.

Minimum 10 experiments should be completed

Course Assessment Method

(CIE: 50 marks, ESE: 50 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	**Preparation/Pre-Lab Work experiments, Viva and Timely completion of Lab Reports / Record (Continuous Assessment)**	**Internal Examination**	**Total**
5	25	20	50

End Semester Examination Marks (ESE):

Procedure/ Preparatory work/Design/ Algorithm	**Conduct of experiment/ Execution of work/ troubleshooting/ Programming**	**Result with valid inference/ Quality of Output**	**Viva voce**	**Record**	**Total**
10	15	10	10	5	50

Submission of Record: Students shall be allowed for the end semester examination only upon submitting the duly certified record. Endorsement by External Examiner: The external examiner shall endorse the record

Text Books:

1. Callister, W. D., & Rethwisch, D. G., *Callister's materials science and engineering* (10th ed.). Wiley, 2018.
2. Kuhn, H., & Medlin, D., *Mechanical testing and evaluation* (Vol. 8). ASM International, 2000.

Reference Books:

1. Gere, J. M., & Goodno, B. J., *Mechanics of materials* (9th ed.). Cengage Learning, 2022.
2. Shackelford, J. F., *Introduction to materials science for engineers* (8th ed.). Pearson, 2022.

MINOR

25MMET301	INTRODUCTION TO SMART MANUFACTURING	Category	L	T	P	R	Credit	Year of Introduction
		VAC	4	0	0	0	4	2025

Preamble: This course introduces the concepts of smart manufacturing and digital transformation in production systems. It covers automated manufacturing systems, CAD/CAM, CIMS, robotics, automated material handling systems, e-manufacturing, cloud-based manufacturing, and Industry 4.0 technologies. Emphasis is placed on integration of information technology, intelligent systems, and cyber-physical systems to enhance productivity, flexibility, and competitiveness in modern industries.

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Prerequisite: None

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Describe automated manufacturing systems, CAD/CAM, CIMS and smart manufacturing concepts.	K2 Understand
CO2	Choose appropriate automated material handling systems and industrial robots based on manufacturing requirements.	K3 Apply
CO3	Apply design principles of AGV and AS/RS systems for smart manufacturing integration.	K3 Apply
CO4	Explain and apply Industry 4.0, IoT, cloud manufacturing and agile manufacturing concepts in modern industrial environments.	K3 Apply

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	1	1	-	1	-	-	-	-	-	2	1	1
CO2	2	2	2	-	2	-	-	-	-	-	2	2	2
CO3	2	3	2	-	2	-	-	-	-	-	2	2	2

CO4	**2**	**2**	**3**	**-**	**2**	**-**	**-**	**-**	**-**	**1**	**2**	**2**	**2**
Avg	**2**	**2**	**2**	**-**	**1.75**	**-**	**-**	**-**	**-**	**1**	**2**	**1.75**	**1.75**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	*	–	*	*	–
CO2	*	*	*	*	*	*	*	*	–
CO3	*	*	*	*	*	*	*	*	–
CO4	*	*	*	*	*	*	*	*	*

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	*

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	**40**	**60**	**2.5 hrs**

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (14 hrs)

Automated Manufacturing Systems – Computerized Manufacturing Support Systems – CAD/CAM – Computer Integrated Manufacturing Systems (CIMS) – Need for automation – Process improvement – Computer-based integration between design, manufacturing and materials management – Introduction to smart manufacturing systems.

Module 2 (14 hrs)

Introduction to robot technology – Basic terminologies – Classification and characteristics of robots – Physical configurations – Structure of industrial robots – Robot programming basics – Applications in manufacturing – Case studies.

Module 3 (14 hrs)

Introduction to material handling systems – Conveyor systems – Automated Guided Vehicle (AGV) systems: guidance, routing, control and design – Automated Storage and Retrieval Systems (AS/RS): components, control systems and applications – Integration of automated material handling and storage systems.

Module 4 (14 hrs)

Agent-based manufacturing – IT-based supply chain – Cloud-based manufacturing – Agile manufacturing – E-manufacturing systems – Evolution of industrial revolutions – Introduction to Industry 4.0 – Cyber-physical systems – Internet of Things (IoT) in manufacturing – Smart supply chain – Industrial case studies.

Text Books:

1. Bahga, A., & Madisetti, V., *Internet of things: A hands-on approach* (1st ed.). CreateSpace Independent Publishing Platform, 2014.
2. Sarath, S., Karle, A. H., Ahasan, M., Raman, V., & Selvakumaran, T., *Introduction to smart manufacturing*. Sree Global Publications, 2024.
3. Skilton, M., & Hovsepian, F., *The 4th industrial revolution: Responding to the impact of artificial intelligence on business*. Springer Nature, 2017.
4. Groover, M. P., *Automation, production systems, and computer integrated manufacturing* (4th ed.). Pearson Education, 2016.
5. Groover, M. P., Weiss, M., Nagel, R. N., & Odrey, G., *Industrial robotics: Technology, programming, and applications* (2nd ed.). McGraw Hill, 2017.

Reference Books:

1. Gilchrist, A., Industry 4.0: *The industrial internet of things* (1st ed.). Apress, 2016.
2. Jeschke, S., Brecher, C., Song, H., & Rawat, D. B., *Industrial internet of things: Cyber manufacturing systems* (1st ed.). Springer, 2017.
3. Erl, T., Mahmood, Z., & Puttini, R., *Cloud computing: Concepts, technology & architecture* (1st ed.). Prentice Hall, 2013.
4. Viswanadham, N., & Narahari, Y., *Performance modeling of automated manufacturing systems* (1st ed.). Prentice Hall, 1994.
5. Saha, S. K., *Introduction to robotics* (2nd ed.). Tata McGraw Hill Education, 2014.

END SEMESTER EXAMINATION - MODEL QUESTION PAPER

Course Code	25MMET301
Course Name	INTRODUCTION TO SMART MANUFACTURING
Max. Marks: 60	Duration: 2.5 Hours

Part A *(Answer all questions. Each question carries 3 marks)*				
Qn No.	**Question**	**Marks**	**CO**	**BL**
1.	Describe automated manufacturing systems and the need for automation in modern industries.	3	1	L2
2.	Explain how CAD/CAM and CIMS support integration between design and manufacturing.	3	1	L2
3.	Use robot configuration characteristics to identify a suitable robot for a manufacturing task.	3	2	L3
4.	Illustrate robot programming steps for a simple pick-and-place manufacturing operation.	3	2	L3
5.	Demonstrate the use of AGV guidance, routing, and control in a smart manufacturing layout.	3	3	L3
6.	Illustrate the components and working of an Automated Storage and Retrieval System (AS/RS).	3	3	L3
7.	Use IoT and cloud manufacturing concepts to improve data sharing in a smart factory.	3	4	L3
8.	Demonstrate the use of agile manufacturing concepts in a modern industrial environment.	3	4	L3
	Part B (*Answer any one full question from each Module. Each carry 9 marks*)			
	Module I			
Qn No.	**Question**	**Marks**	**CO**	**BL**
9	Explain automated manufacturing systems, computerized manufacturing support systems, CAD/CAM, CIMS, and their role in smart manufacturing.	9	1	L2
	OR			

10	Describe the need for automation and process improvement in manufacturing industries with suitable examples.	9	1	L2
	Module II			
Qn No.	**Question**	**Marks**	**CO**	**BL**
11	Use robot selection criteria to identify a suitable industrial robot for a manufacturing cell.	9	2	L3
	OR			
12	Demonstrate robot programming methods and applications using a suitable industrial case.	9	2	L3
	Module III			
Qn No.	**Question**	**Marks**	**CO**	**BL**
13.a	Apply AGV design principles for material movement in a smart manufacturing system.	5	3	L3
13.b	Demonstrate the role of guidance, routing, and control in AGV system operation.	4	3	L3
	OR			
14.a	Use AS/RS components and control systems to develop an automated storage solution for a manufacturing unit.	5	3	L3
14.b	Illustrate the integration of conveyor, AGV, and AS/RS systems in automated material handling.	4	3	L3
	Module IV			
Qn No.	**Question**	**Marks**	**CO**	**BL**
15.a	Use Industry 4.0, cyber-physical systems, and IoT concepts to develop a smart manufacturing information flow.	5	4	L3
15.b	Demonstrate cloud-based manufacturing and smart supply chain concepts in an industrial case.	4	4	L3
	OR			
16.a	Employ agent-based manufacturing and agile manufacturing concepts for flexible production planning.	5	4	L3
16.b	Illustrate e-manufacturing systems and cloud-based manufacturing for modern industrial environments.	4	4	L3

25MMET302	FUNDAMENTALS OF AUTOMOBILE ENGINEERING	Category	L	T	P	R	Credit	Year of Introduction
		VAC	4	0	0	0	4	2025

Preamble: The automobile industry plays a vital role in modern transportation and economic development. This course introduces the fundamental principles, construction, and working of various automobile systems including engine components, transmission systems, steering, suspension, braking, and emerging automotive technologies. The course provides foundational knowledge required for higher-level subjects such as Automotive Engines, Vehicle Dynamics, and Electric & Hybrid Vehicles.

Prerequisite: Nil

Course Outcomes: After the completion of the course, the student will be able to:

CO	Course Outcomes	Knowledge Level
CO1	Explain the history, classification, chassis layout, major components, and basic terminology of automobiles and I.C. engines.	**K2 Understand**
CO2	Describe the construction and operation of engine components, fuel supply, cooling, and lubrication systems.	**K2 Understand**
CO3	Illustrate the working of transmission, steering, and suspension systems used in automobiles.	**K3 Apply**
CO4	Demonstrate the operation of braking, electrical, emission control, hybrid, and electric vehicle systems.	**K3 Apply**

Mapping of course outcomes with program outcomes and program specific outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2	1	–	–	–	–	–	–	–	–	2	1
CO2	3	2	1	–	–	–	1	–	–	–	–	3	1

CO3	3	3	2	–	–	–	–	–	–	–	–	3	2
CO4	3	2	2	–	1	1	2	–	–	–	1	3	2
Avg	**3**	**2.25**	**1.5**	**–**	**1**	**1**	**1.5**	**–**	**–**	**–**	**1**	**2.75**	**1.5**

Mapping of course outcomes with Knowledge and Attitude Profile (WK)

	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
CO1	*	*	*	*	–	–	–	–	–
CO2	*	*	*	*	–	*	–	*	–
CO3	*	*	*	*	*	*	–	–	–
CO4	*	*	*	*	*	*	*	*	–

WKs Mapped with the course

WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
*	*	*	*	*	*	*	*	-

Mark Distribution:

Total Marks	CIE Marks	ESE Marks	ESE Duration
100	**40**	**60**	**2.5 hrs**

Continuous Internal Evaluation Pattern:

Attendance : 5 marks
Continuous Assessment Test : 20 marks
Continuous Assessment Assignment : 15 marks

SYLLABUS

Module 1 (14 hrs)

Introduction - History and development of automobiles, Classification of vehicles, Layout of automobile chassis, Major components of an automobile

I.C. Engines - Classification of I.C. engines, Two-stroke and four-stroke engines, SI and CI engines, Engine terminology (Bore, Stroke, TDC, BDC, CR), Engine performance parameters

Module 2 (14 hrs)

Engine Construction - Cylinder block, Cylinder head, Piston, Piston rings, Connecting rod, Crankshaft, Valves and Valve mechanism

Fuel and Cooling Systems - Carburetor (basics), Fuel injection system (SI & CI engines), Air intake system, Cooling system (Air & Water cooling), Lubrication system

Module 3 (14 hrs)

Transmission System - Clutch – Types and working, Gearbox – Sliding mesh, Constant mesh, Synchromesh, Propeller shaft, Differential and rear axle

Steering and Suspension - Steering geometry, Types of steering gear, Suspension system – Types, Shock absorbers

Module 4 (14 hrs)

Braking System - Mechanical, Hydraulic braking, Disc and Drum brakes, ABS (Anti-lock Braking System)

Electrical & Modern Developments - Battery and charging system, Starting system, Introduction to Hybrid and Electric Vehicles, Emission control techniques

Text Books:

1. Singh, K., *Automobile engineering* (Vol. I & II). Standard Publishers Distributors, New Delhi, 2011.
2. Ramalingam, K. K., *Automobile engineering*. Scitech Publications, 2011.
3. Hillier, V. A. W., *Fundamentals of motor vehicle technology*. Nelson Thornes Ltd., 2004.

Reference Books:

1. Robert Bosch, *Automotive handbook*. SAE International, 2018.
2. Crouse, W. H., & Anglin, D. L., *Automotive mechanics*. McGraw-Hill Education, 2012.
3. Ganesan, V., *Internal combustion engines*. McGraw-Hill Education, 2012.

END SEMESTER EXAMINATION - MODEL QUESTION PAPER

Course Code	**25MMET302**
Course Name	**FUNDAMENTALS OF AUTOMOBILE ENGINEERING**
Max. Marks: 60	Duration: 2.5 Hours

Part A

(Answer all questions. Each question carries 3 marks)

Qn No.	Question	Marks	CO	BL
1	Explain the classification of automobiles based on application and chassis layout.	3	CO1	L2
2	Describe basic I.C. engine terminology: bore, stroke, TDC, BDC and compression ratio.	3	CO1	L2
3	Describe the construction and function of piston, connecting rod and crankshaft in an I.C. engine.	3	CO2	L2
4	Explain the working of fuel injection and cooling systems used in automobiles.	3	CO2	L2
5	Illustrate the operation of a single plate clutch in an automobile transmission system.	3	CO3	L3
6	Demonstrate the function of steering geometry in controlling vehicle direction.	3	CO3	L3
7	Illustrate the operation of Anti-lock Braking System (ABS) during sudden braking on a wet road.	3	CO4	L3
8	Use emission control techniques to reduce pollutants from I.C. engine vehicles.	3	CO4	L3

Part B

(Answer any one full question from each Module. Each carry 9 marks)

Module I

Qn No.	Question	Marks	CO	BL
9	Explain the history and development of automobiles, classification of vehicles, chassis layout and major components of an automobile.	9	CO1	L2
OR				
10	Describe the classification of I.C. engines and explain the working of two-stroke and four-stroke engines with suitable sketches.	9	CO1	L2

Module II

Qn No.	Question	Marks	CO	BL
11	Describe the construction and operation of cylinder block, cylinder head, piston, piston rings, connecting rod, crankshaft and valve mechanism.	9	CO2	L2
OR				
12	Explain the fuel supply, air intake, cooling and lubrication systems used in automobiles.	9	CO2	L2

Module III

Qn No.	Question	Marks	CO	BL
13.a	Illustrate the working of a single plate clutch and explain its role in the automobile transmission system.	5	CO3	L3
13.b	Demonstrate the operation of a differential during vehicle turning.	4	CO3	L3
OR				
14.a	Illustrate the working of sliding mesh, constant mesh and synchromesh gearboxes.	5	CO3	L3
14.b	Use steering geometry parameters to show the effect of caster and camber on vehicle steering.	4	CO3	L3

Module IV

Qn No.	Question	Marks	CO	BL
15.a	Demonstrate the operation of mechanical and hydraulic braking systems used in automobiles.	5	CO4	L3
15.b	Illustrate the operation of ABS during emergency braking.	4	CO4	L3

Qn No.	Question	Marks	CO	BL
OR				
16.a	Demonstrate the operation of battery, charging and starting systems in automobiles.	5	CO4	L3
16.b	Use hybrid and electric vehicle concepts to identify suitable modern automobile applications.	4	CO4	L3

SDG MAPPING (SEMESTER 3)

SEMESTER III	SUSTAINABLE DEVELOPMENT GOALS																
COURSE CODE	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**
25UMBT301				*					*								
25UMET301				*					*		*	*					
25UMET302				*		*	*		*		*		*	*			
25UMET303				*				*	*		*	*	*				
25UAMT304				*				*	*	*							*
25UHUT002			*	*		*	*		*		*	*	*	*	*	*	*
25UMEL305				*				*	*			*	*				
25UMEL306			*	*				*	*		*	*					
25MMET301				*				*	*		*	*	*				*
25MMET302			*	*			*		*		*	*	*				

Note: * indicates course contribution to the corresponding Sustainable Development Goal.

CONSOLIDATED WK MAPPING FOR SEMESTER 3 COURSES

(Knowledge and Attitude Profile Mapping)

Sl. No.	Course Code and Name	WK1	WK2	WK3	WK4	WK5	WK6	WK7	WK8	WK9
1	25UMBT301 - FOURIER TRANSFORMS AND COMPLEX ANALYSIS	*	*	*	*	*	-	-	*	-
2	25UMET301 - STRENGTH OF MATERIALS	*	*	*	*	*	-	-	-	-
3	25UMET302 - FLUID MECHANICS AND HYDRAULIC MACHINES	*	*	*	*	*	*	*	*	*
4	25UMET303 - PRINCIPLES OF MANUFACTURING	*	*	*	*	*	*	*	*	-
5	25UAMT304 - FUNDAMENTALS OF ARTIFICIAL INTELLIGENCE & DATA SCIENCE	*	*	*	*	*	-	-	-	-
6	25UHUT002 - SUSTAINABILITY AND ETHICS IN ENGINEERING	*	*	*	*	*	*	*	*	*
7	25UMEL305 - MACHINING & ADDITIVE MANUFACTURING LAB	*	*	*	*	*	*	*	*	-
8	25UMEL306 - MECHANICAL AND MATERIAL TESTING LAB	*	*	*	*	*	*	*	*	-
9	25MMET301 - INTRODUCTION TO SMART MANUFACTURING	*	*	*	*	*	*	*	*	*
10	25MMET302 - FUNDAMENTALS OF AUTOMOBILE ENGINEERING	*	*	*	*	*	*	*	*	-
WKs Mapped with Semester 3		*	*	*	*	*	*	*	*	*