TECHNO INDIA UNIVERSITY

WEST BENGAL

CURRICULUM AND SYLLABUS

For

M. TECH

IN

MECHANICAL ENGINEERING

(Manufacturing)

AY-2023-24

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM

First Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIU-PME-T103	Advanced Material Science	3	0	0	3
TIU-PME-T105	Theory of Machining	3	0	0	3
TIU-PME-E107	Modern Manufacturing Processes (Elective I)	3	0	0	3
TIU-PME-E109A	Rapid Prototyping (Elective II)	3	0	0	3
TIU-PME-E109B	Operations Research (Elective II)	3	0	0	3
TIU-PMA-T115	Advanced Numerical Analysis	3	1	0	4
Practical					
TIU-PME-L101	Advanced Manufacturing Lab 1	0	0	4	2
Sessional					
TIU-PME-S199	Seminar 1	0	0	4	2
Total Credits					**20**

Second Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Theory					
TIU-PME-T102	Metal Forming Processes	3	1	0	4
TIU-PME-T104	Robotics	3	1	0	4
TIU-PME-E100	Materials Characterization (Elective - III)	3	1	0	4
TIU-PME-E104	Product Development and CIM (Elective IV)	3	1	0	4
Practical					
TIU-PME-L102	Advanced Manufacturing Lab II	0	0	4	2
Sessional					
TIU-PME-S198	SEMINAR II	0	0	4	2
Total Credits					**20**

Third Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Practical					
TIU-PME-P201	M. Tech Project I	0	0	24	12
Total Credits					**12**

Fourth Semester

Course Code	Course Title	Contact Hrs. / Week			Credit
		L	T	P	
Practical					
TIU-PME-P202	M. Tech Project II	0	0	24	12
Total Credits					**12**

DETAIL SYLLABUS

Semester 1

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Year, 1st Semester
Course Title: Advanced Material Science	**Subject Code:** TIU-PME- T103
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** Theory–3
Prerequisite Course: B. Tech. in Mechanical Engineering	

Course Objective

Enable the students to

1. Develop a comprehensive understanding of mechanical properties
2. Analyze various failure mechanisms of materials
3. Gain knowledge of non-ferrous materials, along with an in-depth understanding of the powder metallurgy process
4. Understanding nanostructured materials and nanotechnology

Course Outcome:

On completion of the course, the student will be able to:

CO1	Understanding fundamental concepts of mechanical behaviour of metallic materials and solving simple numerical	K2
CO2	Ability to apply theoretical models of materials failure to analyze failure modes in various materials	K3
CO3	Familiar with non-ferrous metals such as aluminium, copper and nickel based alloys	K2
CO4	Insight into powder metallurgy process	K2
CO5	Develop a foundational knowledge of nanotechnology and nano-structured materials	K2
CO6	Apply knowledge of material characterization techniques to interpret experimental data and predict material behavior	K3

Course Content

Module-1:	**Mechanical Properties**	**9 hours**
Stress-strain diagram of metallic materials; Hardness; Fracture toughness (impact test); Creep;		

Fatigue		
Module-2:	**Failures of Materials**	**10 hours**
Theoretical cohesive strength of metals, Griffith's theory of brittle fracture, Fractographic aspects of fracture, Mechanism of brittle and ductile fracture, Fracture of composites, Notch effects; Mechanism of fatigue crack nucleation and propagation, Factors affecting fatigue crack growth rate, Influence of load interaction, Short fatigue crack.		
Module-3:	**Non-ferrous materials**	**4 hours**
Aluminum base alloys; Copper base alloys; Nickel base alloys.		
Module-4:	**Powder Metallurgy**	**6 hours**
Process description, Maintenance of metal powders, Blending of powders, Compaction, Pre-sintering, Sintering, Secondary operation, Products of powder metallurgy, Advantage of the process, Disadvantages and limitations.		
Module-5:	**Nano-structured Materials**	**10 hours**
Background, Approaches towards "Nano Technology", Types of nanostructured materials, Emergence of nanotechnology, Challenges in nanotechnology, Understanding of nanomaterials, Surface Energy, Stability and surface energy, Surface relaxation, Surface restructuring, Surface adsorption, Composition segregation, Metal nanoparticle synthesis, Grain refinement mechanism during Severe Plastic Deformation, Mechanical properties of nanocrystalline materials.		
TOTAL LECTURES		**39 hours**

Recommended Books:

1. Mechanical Metallurgy by G.E. Dieter, McGraw Hill.
2. Material Science and Engineering and Introduction by W. D. Callister, Wiley.
3. The Science and Engineering of Materials by S.R. Askland and P.P. Phule, Thomson Brooks/Cole.
4. Physical Metallurgy, V. Singh, Standard Publishers.
5. Principles of Materials Science by W.F. Smith, McGraw Hill.
6. Heat Treatments: Principles and Techniques by T.V. Rajan, C.P. Sharma and A. Sharma, Prentice Hall.
7. Introduction of Materials Science for Engineers by J.F. Shackelford and M.K. Muralidhara, Pearson.
8. Guozhong Cao, Nanostructures & Nanomaterials, Imperial College Press.
9. Michael J. Zehetbauer and Yuntian Theodore Zhu, Bulk Nanostructured Materials, WILEY-VCH.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										**PROGRAM SPECIFIC OUTCOMES (PSO)**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	-	-	-	-	-	-	2	2	-	-	-
CO2	3	2	-	-	-	-	-	-	-	-	2	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO4	2	-	-	-	-	-	-	-	-	-	2	-	-	-

CO5	2	-	-	-	-	1	-	-	-	-	2	-	-	2
CO6	3	-	2	2	-	-	-	-	-	-	3	-	-	-

TECHNO INDIA UNIVERSITY
W E S T B E N G A L

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Theory of Machining	**Subject Code:** TIU-PME-T105
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand machining principles, cutting tool geometry, and reference systems
2. Analyze chip formation, cutting forces, and thermal aspects in machining.
3. Apply concepts of tool wear, tool life, and cutting fluids for efficient machining.
4. Optimize machining economics and process parameters for industrial applications.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Identify fundamental machining principles, cutting tool geometry, and tool reference systems for different machining operations.	K1
CO2	Explain chip formation mechanisms, types of chips, and the effect of effective rake on machining outcomes.	K2
CO3	Analyze the mechanics of cutting forces, power consumption, and energy-efficient machining strategies.	K4
CO4	Evaluate the influence of heat generation, cutting temperature modeling, and cutting fluids on machining performance.	K5
CO5	Assess tool wear mechanisms, failure modes, tool life prediction, and material selection for high-performance machining	K5
CO6	Apply the concepts of machining economics to optimize cutting parameters for enhanced tool life, surface quality, and cost-effectiveness.	K3

COURSE CONTENT :

MODULE 1:	**FUNDAMENTALS OF MACHINING AND CUTTING TOOL**	**7 Hours**

	GEOMETRY	
Machining, definition and objectives. Geometry of cutting tools; turning, milling and drilling – in different reference systems like machine reference system, tool reference system and work reference system. Sharpening and re-sharpening of cutting tools		
MODULE 2:	**CHIP FORMATION AND CUTTING MECHANICS**	**6 Hours**
Mechanism of chip formation by single point tools. Types of chips and their characteristics. Effective rake.		
MODULE 3:	**MACHINING MECHANICS AND CUTTING FORCES**	**7 Hours**
Mechanics of machining, theoretical estimation and experimental determination of cutting forces and power consumption		
MODULE 4:	**THERMAL ASPECTS OF MACHINING AND CUTTING FLUIDS**	**7 Hours**
Thermodynamics of machining, sources of heat generation, cutting temperature modelling, measurement of cutting temperature. Cutting fluids; purpose, essential characteristics, selection and methods of application		
MODULE 5:	**CUTTING TOOL WEAR, LIFE, AND MATERIALS**	**6 Hours**
Cutting tools; methods of failure, mechanics of tool wear, essential properties, assessment of tool life and cutting tool materials.		
MODULE 6:	**MACHINING ECONOMICS AND OPTIMIZATION**	**6 Hours**
Economics of machining; principal objectives, main parameters and their role on cutting forces, cutting temperature, tool life and surface quality, selection of optimum combination of parameters.		
TOTAL LECTURES		**39 Hours**

Books:

1. Machining and Machine Tools, A. B. Chattopadhyay, Wiley, Second Edition.
2. Metal Cutting and Design of Cutting Tools-Jigs and Fixtures, N. K. Mehta, McGraw Hill Education lndia, Pvt Ltd.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										**PROGRAM SPECIFIC OUTCOMES (PSO)**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	2	-	-	-	-	-	-	3	-	-	-
CO2	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	2	-	-	-	-	-	-	-	2	-	-	-
CO4	2	-	-	3	-	1	-	-	-	-	-	2	-	-
CO5	2	-	3	-	-	-	-	-	-	-	-	3	-	-
CO6	3	-	-	2	-	1	-	-	-	1	-	2	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Modern Manufacturing Processes	**Subject Code:** TIU-PME-E107
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand non-traditional machining techniques like abrasive, ultrasonic, and low-stress grinding.
2. Explore electrochemical and chemical processing for machining and surface modification.
3. Analyze thermal energy-based methods, including laser, electron beam, and plasma techniques.
4. Evaluate hybrid and advanced manufacturing trends, including electroforming and nano-manufacturing.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Recall the principles and types of non-traditional, electrochemical, thermal, and hybrid machining processes	K1
CO2	Explain the working principles, advantages, and limitations of advanced machining techniques.	K2
CO3	Analyze thermal energy-based material processing techniques and their applications.	K4
CO4	Apply machining and material processing techniques to solve industrial challenges.	K3
CO5	Evaluate the suitability of various advanced manufacturing techniques for specific applications.	K5
CO6	Compare hybrid and conventional machining techniques based on efficiency and applications.	K4

COURSE CONTENT :

MODULE 1:	ADVANCED NON-TRADITIONAL MACHINING	10 Hours
lmpact erosion. Theory and application of machining by Abrasive Jet, Water Jet, Water abrasive and Abrasive Flow, Ultrasonic processing of materials (machining, welding, cleaning, hardening), total Form Machining and low stress grinding.		
MODULE 2:	**ELECTROCHEMICAL AND CHEMICAL MATERIAL PROCESSING**	**9 Hours**
Electrochemical processing of materials (surface modification, Machining, forming, polishing, sharpening, honing and turning); Micro hole drilling: Electro-stream and Shaped Tube. Chemical and Thermo-chemical processing (machining, electroless plating and surface modification).		
MODULE 3:	**THERMAL ENERGY-BASED MATERIAL PROCESSING TECHNIQUES**	**10 Hours**
Thermal energy methods of material processing (machining/welding/heat treatment) by Electro-discharge, Laser and Electron beam, Plasma arc and lon beam. Physical Vapour and Chemical Vapour Deposition, and Plasma Spraying. High Energy Rate		
MODULE 4:	**HYBRID AND ADVANCED MANUFACTURING TECHNIQUES**	**10 Hours**
Forming and Electroforming. Theory of hybridisation and advantages of evolved processes: ECG, ECDG, RUM, Laser assisted processing etc. and futuristic trends in manufacturing (Micro to nano manufacturing & RPT)		
TOTAL LECTURES		**39 Hours**

Books:

1. Modern Manufacturing: Materials, Processes and Systems, Casan Anderson, Willford Publishers.
2. M. P. Groover, Fundamentals of Modern Manufacturing: Materials, Processes, and Systems, Wiley, 2020.
3. G. Boothroyd, P. Dewhurst, W. Knight, Product Design for Manufacture and Assembly, CRC Press, 2010.
4. S. Kalpakjian, S.R. Schmid, Manufacturing Engineering and Technology, Pearson, 2018.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	2	-	-	-	-	-	-	2	-	-	-
CO2	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO3	2	-	3	-	-	1	-	-	-	-	-	3	-	-
CO4	2	3	2	-	-	-	-	-	-	-	3	-	2	-
CO5	2	2	-	-	-	-	-	-	-	1	2	3	-	-
CO6	2	-	-	3	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Rapid Prototyping	**Subject Code:** TIU-PME-E109A
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Describe rapid prototyping concepts, classifications, and integration with flexible manufacturing systems and computer-integrated manufacturing.
2. Utilize computer-aided design and computer-aided manufacturing tools and rapid prototyping techniques for prototype development.
3. Compare various rapid prototyping technologies and their industrial applications.
4. Optimize rapid prototyping programming, slicing methods, and support structures for efficiency.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Describe the principles of rapid prototyping, its evolution, and its role in modern manufacturing.	K2
CO2	Utilize computer-aided design and computer-aided manufacturing tools in rapid prototyping workflows.	K3
CO3	Differentiate between various rapid prototyping technologies based on materials, layering methods, and energy sources.	K4
CO4	Compare the capabilities and limitations of different rapid prototyping techniques such as stereolithography, fused deposition modeling, and selective laser sintering.	K4
CO5	Assess rapid prototyping process parameters, programming techniques, and slicing methods for accuracy and efficiency.	K5
CO6	Enhance support structure design and material selection to improve the performance of rapid prototyping applications.	K5

COURSE CONTENT :

MODULE 1:	**RAPID PROTOTYPING PREREQUISITE**	**10 Hours**

Rapid Prototyping Prerequisite; Non-traditional Manufacturing Processes Classification of manufacturing processes, Different manufacturing systems, lntroduction to rapid prototyping (RP), Need of Rp in context of batch production, FMS and CIM and their application.		
MODULE 2:	**BASIC PRINCIPLES OF RP**	**8 Hours**
Steps in RP, Process chain in RP in integrated CAD CAM environment, Advantages of RP, Classification of different RP techniques based on raw materials, layering technique (2-D or 3-D) and energy sources		
MODULE 3:	**PROCESS TECHNOLOGY AND COMPARATIVE STUDY**	**16 Hours**
Process technology and comparative study of: Stereo-lithography (SL) with photo polymerization, SL with liquid thermal polymerization, Solid foil polymerization, Selective laser sintering, Selective powder binding, ballistic particle manufacturing both 2-D and 3-D, Fused deposition modelling, Shape melting, Laminated object manufacturing, Solid ground curing, Repetitive masking and deposition, Beam interference solidification, Holographic interference solidification		
MODULE 4:	**SPECIAL TOPIC ON RP**	**5 Hours**
Special topic on RP using metallic alloys, Programming in RP, Modelling, Slicing, lnternal hatching, Surface skin fills, Support structure		
TOTAL LECTURES		**39 Hours**

Books:

1. Rapid Prototyping: Principles and Applications (third edition), C. K. Chua and K. F. Leong, World Scientific Publishing Pvt. Ltd.
2. Rapid Prototyping, M. Adithan, Atlantic Publishers & Distributors.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										**PROGRAM SPECIFIC OUTCOMES (PSO)**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	2	2	-	3	-	-	-	-	-	-	-	3	-	-
CO3	3	-	-	2	-	-	-	-	-	-	-	2	-	-
CO4	2	-	2	-	-	-	-	-	-	-	-	2	-	-
CO5	2	2	-	-	-	-	-	-	-	1	2	3	-	-
CO6	2	-	-	3	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Operations Research	**Subject Code:** TIU-PME-E109B
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Describe key concepts of Operations Research and its engineering applications.
2. Implement optimization techniques like Simplex, Transportation, and Assignment Models for problem-solving
3. Examine queuing systems, inventory models, and project management for efficiency improvements.
4. Assess decision-making strategies and game theory for engineering and management optimization.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	Explain the fundamental concepts of Operations Research and its role in engineering decision-making.	K2
CO2	Apply Linear Programming and Simplex methods to optimize mechanical engineering processes.	K3
CO3	Evaluate transportation and assignment models to enhance resource allocation.	K5
CO4	Analyze queuing and simulation techniques for improving production and service operations.	K4
CO5	Implement inventory control strategies, including EOQ, JIT, and ABC analysis, in industrial applications.	K3
CO6	Compare decision-making strategies and game theory approaches to optimize complex engineering problems.	K4

COURSE CONTENT :

MODULE 1:	**INTRODUCTION TO OPERATIONS RESEARCH AND LINEAR PROGRAMMING (LPP)**	**8 hours**
Introduction to Operations Research: Definition, scope, applications in engineering, limitations. Linear Programming Problem (LPP) – Formulation and Graphical Method. Simplex Method: Standard forms, feasible solutions, optimality conditions. Duality in LPP: Duality concepts,		

economic interpretation of duality, sensitivity analysis. Applications of LPP in Mechanical Engineering.		
MODULE 2:	**TRANSPORTATION AND ASSIGNMENT MODELS**	**7 hours**
Transportation Problem: Formulation, initial feasible solution methods (North-West Corner Rule, Least Cost, Vogel's Approximation Method). Optimization in Transportation – MODI method. Assignment Problem: Formulation, Hungarian Method. Unbalanced, Degeneracy, and Maximization Problems in Transportation and Assignment.		
MODULE 3:	**QUEUING THEORY AND SIMULATION**	**6 hours**
Arrival and service patterns, queue disciplines. Single-channel and Multi-channel Queues. Applications of Queuing Theory in Mechanical and Production Systems. Introduction to Simulation: Types, steps in simulation study.Monte Carlo Simulation and its applications.		
MODULE 4:	**INVENTORY MANAGEMENT AND MODELS**	**6 hours**
Inventory Concepts and Classifications, Inventory Control Models: EOQ, EPQ, and Quantity Discount models. Deterministic and Probabilistic Inventory Models. ABC Analysis and Selective Inventory Control Techniques. Just-in-Time (JIT) and its applications in Mechanical Engineering		
MODULE 5:	**NETWORK MODELS AND PROJECT MANAGEMENT**	**6 hours**
Network Analysis, Terminology, network diagrams. Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT). Time-Cost Trade-Off Analysis. Resource Allocation and Levelling. applications of CPM/PERT in Mechanical Engineering Projects		
MODULE 6:	**DECISION ANALYSIS AND GAME THEORY**	**6 hours**
Decision Analysis, Decision-making under certainty, risk, and uncertainty. Decision Trees and Payoff Tables. Game Theory: Introduction, types of games, strategies. two-Person Zero-Sum Games, Minimax and Max-min strategies. Applications of Game Theory in Operations Research		
TOTAL LECTURES		**39 Hours**

Books:

1. Operations Research by J.K. Sharma, Macmillan.
2. Operations Research: An Introduction by H.A. Taha, Pearson
3. Production, Planning and Inventory Control by S.L.Narasimhan, D.W.McLeavey, J.Billington, Prentice Hall.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	1	2	3	4
CO1	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	3	-	-	2	-	-	-	-	-	-	-	3	-	-
CO3	2	2	-	-	-	-	-	-	-	-	2	3	-	-
CO4	2	-	2	-	-	-	-	-	-	-	2	-	-	-
CO5	2	-	-	2	-	1	-	-	-	-	2	2	-	-
CO6	3	-	-	2	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY
W E S T B E N G A L

Department of Mathematics

Program: M. Tech in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: ADVANCED NUMERICAL ANALYSIS	**Subject Code:** TIU-PMA-T115
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Learning the Numerical techniques to obtain approximate solutions of various mathematical problems which cannot be solved analytically.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	To solve a system of linear equations through direct methods.	K3
CO2	To deduce a system of linear equations through indirect methods.	K4
CO3	To calculate eigen value problem.	K4
CO4	To apply numerical methods to approximate a function.	K3
CO5	To deduce least square curve fitting.	K4
CO6	To examine numerical solution of initial value problems.	K4

COURSE CONTENT :

MODULE 1:		**8 Hours**
Solution of Simultaneous Linear Equations - Direct Methods – Gauss Elimination, Gauss Jordan, LU Decomposition, Matrix Inversion.		
MODULE 2:		**8 Hours**
Iterative Methods – Gauss - Jacobi, Gauss – Seidel		
MODULE 3:		**4 Hours**
Relaxation method. Necessary and sufficient conditions for convergence. Speed of convergence. (Proofs not required) S.O.R. and S.U.R. methods. Gerschgorin's circle theorem. (Statement only).		
MODULE 4:		**5 Hours**
Eigen value problem – Numerical largest value, Determination of eigen value by iterative methods.		
MODULE 5:		**5 Hours**
Quadratic Approximation, Cubic Spline Interpolation.		
MODULE 6:		**7 Hours**

Least Square Curve Fitting, nonlinear regression		
MODULE 7:		**8 Hours**
Numerical solution of initial value problems by Euler, Modified Euler, Runge-Kutta and Predictor-Corrector method.		
TOTAL LECTURES		**45 Hours**

Textbooks:
1. Dr. B. S. Grewal – Numerical Methods in Engineering and Science
2. K Das – Numerical Methods

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										**PROGRAM SPECIFIC OUTCOMES (PSO)**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	2	-	-	-	-	-	-	2	-	-	-
CO2	3	-	-	2	-	-	-	-	-	-	-	2	-	-
CO3	2	-	2	-	-	-	-	-	-	-	2	-	-	-
CO4	3	-	-	2	-	-	-	-	-	-	-	2	-	-
CO5	2	-	-	2	-	-	-	-	-	-	2	-	-	-
CO6	2	-	3	-	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1stSem.
Course Title: Advanced Manufacturing Lab 1	**Subject Code:** TIU-PME-L101
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE :

Enable the student to:

1. Understand the construction and working principles of conventional and non-conventional machining processes.
2. Perform basic lathe operations such as step turning, facing, and taper turning with precision.
3. Compare machining techniques based on material removal mechanisms and efficiency.
4. Optimize machining parameters for improved surface finish and accuracy.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Explain the construction, working principles, and applications of lathe, shaper, EDM, abrasive jet, and ultrasonic machining processes.	K2
CO2	Perform step turning, facing, plain turning, and taper turning operations on a lathe while ensuring precision and dimensional accuracy	K3
CO3	Demonstrate the use of a shaper machine for grooving operations and analyze its machining characteristics.	K3
CO4	Illustrate the working principles and applications of Electric Discharge Machining (EDM) and evaluate its advantages over conventional machining methods.	K4
CO5	Compare the material removal mechanisms, operational efficiency, and surface finish in Abrasive Jet Machining (AJM) and Ultrasonic Machining (USM)	K4
CO6	Evaluatemachining parameters for different processes to optimize efficiency, accuracy, and surface quality in both conventional and non-conventional machining operations.	K5

COURSE CONTENT :

EXPERIMENT 1:		**3 Hours**
Study of Lathe Machine		
Experiment 2:		**3 Hours**
To perform step turning operations on the given Mild Steel Work-piece as per the given drawing		
Experiment 3:		**6 Hours**
To machine a work-piece by facing, plain turning and taper turning operation using a lathe.		
Experiment 4:		**3 Hours**
Study of Shaper Machine and Perform the Grooving operation		
Experiment 5:		**3 Hours**

Demonstration of Electric Discharge Machine with various working principle		
Experiment 6:		**6 Hours**
Demonstration of Abrasive Jet Machining and Ultrasonic Machining		
TOTAL LECTURES		**24 Hours**

Books:

1. P.N. Rao, Manufacturing Technology Vol 2-Metal Cutting and Machine Tools, Tata McGraw Hill.
2. P.K. Mishra, Non-Conventional machining, Narosa Publishing House

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										**PROGRAM SPECIFIC OUTCOMES (PSO)**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	2	-	-	-	-	-	-	2	-	-	-
CO2	2	2	-	-	-	-	-	-	-	-	3	-	-	-
CO3	2	-	2	-	-	-	-	-	-	-	2	-	-	-
CO4	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO5	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO6	2	-	2	-	-	1	-	-	-	-	2	2	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Seminar-I	**Subject Code:** TIU-PME-S199
Contact Hours/Week: 0-0-4 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE :

Enable the student to:

1. Identify emerging technologies and concepts in Manufacturing Science and Production Engineering.
2. Analyze advancements, applications, and research trends in manufacturing.
3. Construct a technical seminar with research insights and case studies.
4. Assess industrial challenges and propose innovative solutions.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Understand contemporary topics in Manufacturing Science and Production Engineering.	K2
CO2	Apply research-based learning to analyze technical advancements in manufacturing.	K3
CO3	Examine industrial applications and case studies related to advanced manufacturing.	K4
CO4	Evaluate challenges and limitations of emerging manufacturing technologies.	K5
CO5	Develop a structured seminar with well-researched content and technical depth.	K6
CO6	Propose innovative solutions for industrial problems using research insights.	K6

COURSE CONTENT :

SYLLABUS
The seminar aims to provide students with an opportunity to explore advanced and emerging topics in Manufacturing Science and Production Engineering. It encourages research-based learning, critical thinking, and effective presentation skills while keeping students updated with the latest trends in the industry. **Scope and Guidelines** Each student must select a relevant and contemporary topic in Manufacturing Science or Production Engineering. The seminar will focus on innovative concepts, recent advancements,

industrial applications, and research developments. Students can choose from the following broad categories, or they can propose a unique topic (subject to approval by faculty members): The topics are mainly based on Advanced Manufacturing Processes, Industry 4.0 and Smart Manufacturing, Manufacturing Automation and Robotics, Computer-Integrated Manufacturing and Process Optimization, Sustainable and Green Manufacturing, Advancements in Materials for Manufacturing, etc. Each student will be required to prepare and present a 30-minute seminar followed by a 10-minute Q&A session. **The presentation must include**: Introduction to the Topic – Definition, relevance, and industrial significance Technical Background – Working principles, processes, and methods involved Recent Advancements – Research trends, technological innovations, and industry adoption Applications and Case Studies – Practical implementations in different sectors Challenges and Future Trends – Existing issues, limitations, and possible future developments Conclusion – Summary of key points and student's perspective on the topic	

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	2	-	3	-	-	-	-	-	-	-	3	-	-	-
CO3	2	-	-	2	-	-	-	-	-	-	2	2	-	-
CO4	2	-	-	2	-	1	-	-	-	-	-	2	-	-
CO5	-	2	-	-	-	-	-	2	3	-	-	-	3	-
CO6	2	-	2	-	-	-	-	-	2	2	2	2	-	2

Semester 2

TECHNO INDIA UNIVERSITY
W E S T B E N G A L

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Metal Forming Processes	**Subject Code:** TIU-PME-T102
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. Describe metal forming principles, classifications, and equipment selection with safety considerations.
2. Examine plasticity theory, stress-strain behavior, and yield criteria for material deformation.
3. Assess forming processes like forging, rolling, and extrusion using analytical and numerical methods.
4. Utilize powder metallurgy techniques for material processing and fabrication optimization.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Explain metal forming fundamentals, classifications, and forming equipment selection, considering safety and automation	K2
CO2	Interpret plasticity principles, stress-strain behavior, yield criteria, and their effects on material deformation.	K3
CO3	Analyze different forming processes, including forging, rolling, extrusion, and deep drawing, using theoretical and numerical approaches.	K4
CO4	Evaluate process variables, formability tests, and forming limit diagrams to optimize metal forming operations.	K5
CO5	Assess powder metallurgy techniques, including powder production, compaction, and sintering, for material processing applications.	K5
CO6	Apply yield criteria and flow rules to powder metallurgy and metal forming for improved process efficiency and quality control.	K3

COURSE CONTENT :

MODULE 1:	**FUNDAMENTALS OF METAL FORMING AND FORMING EQUIPMENT**	**9 Hours**
Introduction of metal forming as a manufacturing process, and its relation with other processes, Metal Forming from systems point of view, Advantages of metal forming as a manufacturing		

process, Classifications of metal forming processes, Forming equipment's, Presses (mechanical, hydraulic).		
MODULE 2:	**PLASTICITY THEORY AND MATERIAL BEHAVIOR IN METAL FORMING**	**10 Hours**
Theoretical analysis (theory of plasticity), Stress-strain relationship, Strain hardening, Material incompressibility, Work of plastic deformation, Work hardening, Yield criteria, Flow rule, Yield criterion and flow rule for Anisotropic material, lnitiation and extent of plastic flow (micro structural point of view)		
MODULE 3:	**ANALYSIS OF FORMING PROCESSES AND METAL FORMING OPERATIONS**	**18 Hours**
Analysis of forming processes, Slab analysis: Open-die forging, Plate drawing, Flat rolling, Deep drawing of sheet, Other methods of analysis like FEM, upper bound, slip line field. Overview of various metal forming operations: Forging; open-die forging, closed-die forging, coining, nosing, upsetting, heading, extrusion and tooling, Rod, wire and tube drawing, Rolling; flat rolling, shape rolling and tooling, Sheet forming; blanking, piercing, press bending, deep drawing, stretch forming, spinning, hydro forming, rubber-pad forming, explosive forming, Formability of sheet, Formability tests, Forming limit diagrams, Process simulation for deep drawing and numerical approaches.		
MODULE 4:	**POWDER METALLURGY AND FABRICATION TECHNIQUES**	**8 Hours**
Powdered metals and fabrication procedures, Applications, Preparation of powders, Compacting and sintering, Yield criteria and flow rules, Hot and cold pressing.		
TOTAL LECTURES		**45 Hours**

Books:

1. Fundamentals of Metal Forming Processes, B. L. Juneja, New Age lnternational Publishers
2. Modelling Techniques for Metal Forming Processes, G. K. Lal, Narosa Publishing House

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										**PROGRAM SPECIFIC OUTCOMES (PSO)**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	2	-	1	-	-	-	-	2	-	-	-
CO2	3	-	-	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	2	-	-	-	-	-	-	-	3	-	-	-
CO4	2	-	3	-	-	1	-	-	-	-	-	2	-	-
CO5	2	-	2	-	-	-	-	-	-	-	2	2	-	-
CO6	3	-	2	-	-	1	-	-	-	-	2	2	-	-

TECHNO INDIA UNIVERSITY
W E S T B E N G A L

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Robotics	**Subject Code:** TIU-PME-T104
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

5. Get a basic knowledge of robotics and its applications in various domains
6. Be acquainted with different methods of spatial descriptions and transformations
7. Undesrstand the concepts of forward and inverse kinematics of manipulators

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	To be able to get a basic knowledge of Robotics and its applications in various domains.	K2
CO2	To be acquainted with the different methods of spatial descriptions and transformations	K2
CO3	To be able to understand the concepts of forward kinematics in manipulators	K4
CO4	To be able to understand the concepts of reverse kinematics in manipulators	K3
CO5	To be able to formulate rotational and linear velocities of rigid bodies in manipulators	K3
CO-6:	To be able to formulate Jacobians in the force domain and to derive the Cartesian transformation of velocities and static forces	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**2 Hours**
Introduction: background, description of position and orientation, forward and inverse kinematics of manipulators, velocities, static forces and singularities, robot dynamics, trajectory generation and path planning, position and force control of manipulators.		
MODULE 2:	**SPATIAL DESCRIPTIONS AND TRANSFORMATIONS**	**10 Hours**
Spatial Descriptions and Transformations: positions, orientations and frames, changing descriptions from frame to frame, translation and rotation operators, mappings involving general frames, fixed angles and Euler angles and singularities therein, equivalent axis-angle representation.		
MODULE 3:	**FORWARD KINEMATICS OF MANIPULATORS**	**11 Hours**

Forward Kinematics of Manipulators: link description, link-connection description, link parameters, D-H notation, derivation of link transformation equations for forward kinematics, forward kinematics of some industrial robots.		
MODULE 4:	**INVERSE KINEMATICS OF MANIPULATORS**	**11 Hours**
Inverse kinematics of manipulators: introduction, solvability, existence of solutions, multiple solutions, closed form solution techniques, geometric and algebraic solution methods		
MODULE 5:	**JACOBIANS: VELOCITIES AND STATIC FORCES**	**11 Hours**
Jacobians: Linear and rotational velocities of rigid bodies, velocity propagation from link to link, Jacobians, singularities, static forces in manipulators.		
TOTAL LECTURES		**45 Hours**

Books:

1. Introduction to Robotics (Mechanics and Control), by J.J. Craig, Pearson Educational International.
2. Introduction to Robotics (Analysis, Control and Applications) by S.B. Niku, Wiley
3. Robotics (Fundamental Concepts and Analysis), by A. Ghosal, Oxford University Press.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)												**PROGRAM SPECIFIC OUTCOMES (PSO)**		
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
CO1	3	-	-	-	-	-	-	-	-	-	2	-	-	-	-
CO2	3	-	-	2	-	-	-	-	-	-	-	2	-	-	-
CO3	3	-	-	2	-	-	-	-	-	-	-	2	-	-	2
CO4	3	-	2	-	-	-	-	-	-	-	2	-	-	-	-
CO5	2	-	-	3	-	-	-	-	-	-	-	2	-	-	-
CO6	2	-	2	3	-	-	-	-	-	-	2	2	-	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1^{st} Year, 2^{nd} Semester
Course Title: Materials Characterization	**Subject Code:** TIU-PME- E100
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** Theory–4
Prerequisite Course: B. Tech. in Mechanical Engineering	

Course Objective

Enable the students to

- ❖ Develop a comprehensive understanding of diffraction techniques
- ❖ Acquire knowledge of optical and electron microscopy techniques
- ❖ Learn the principles and applications of spectroscopic and surface analysis techniques
- ❖ Understand the concepts of thermal and mechanical characterization techniques

Course Outcome

On completion of the course, the student will be able to:

CO1	Explain the principles of diffractions and describe phase analysis techniques	K2
CO2	Apply the concept of microscopy techniques for material characterization	K3
CO3	Analyze and interpret microstructural and compositional data	K4
CO4	Evaluate surface properties and material thickness measurements	K5
CO5	Perform and evaluate material behavior using thermal and mechanical techniques	K5
CO6	Develop comprehensive reports integrating findings from microscopy, diffraction, and spectroscopy data	K6

Course Content

Module-1:	**Structure analysis tools**	**8 hours**
X-ray diffraction; Phase identification, indexing and lattice parameter determination, Analytical line profile fitting using various models; Neutron diffraction; Reflection High energy electron Diffraction (RHEED), Low energy Electron Diffraction (LEED).		
Module-2:	**Microscopy techniques**	**30 hours**
Introduction to Microscopes, Concepts of resolution. Optical microscopy (OM):Definition, Magnification, Types: Bright-field, Dark field, Phase		

contrast, Grain Size determination, Differential Interference Contrast Microscope, Fluorescence microscope, Principle of Fluorescence microscope. Electron Microscope: Basics and Principles, Concept of Resolution, Electron-Atom Interaction. Scanning Electron Microscope: Principles, Interaction with sample, Kanaya-Okayama Depth penetration formula, Analysis of micrographs, Energy Dispersive X-ray Spectroscopy (EDS), Fractography. Transmission Electron Microscopy (TEM): Sample Preparation, Imaging Methods: Bright-field imaging mode, Dark-field imaging mode, Diffraction mode; Analysis of SAED pattern, High-Resolution TEM, HRTEM Imaging Modes, Composition Analysis, Electron Energy Loss Spectroscopy (EELS). Rutherford backscattering spectrometry: Introduction and principle, Differential scattering cross section, Yield for thin target materials, Experiment of thickness determination. Atomic Force Microscopy: Working principle, Imaging Modes: Contact mode, Tapping Mode, Non-contact Mode, Image Analysis. Magnetic Force Microscopy (MFM): Working Principle, Difference from AFM. Different types of Electron Microscopy: Scanning Probe Microscopy, Scanning Tunneling Microscopy (STM), Scanning Thermal Microscopy (SThM), Scanning Nonlinear Dielectric Microscopy (SNDM).		
Module-3:	**Thermal analysis techniques**	**3 hours**
Introduction, Differential thermal analysis (DTA), Differential Scanning Calorimetry (DSC), Thermo-gravimetric analysis (TGA).		
Module-4:	**Mechanical Testing**	**4 hours**
Micro- and Nano-indentation testing, Viscoelastic behaviour, etc.		
TOTAL LECTURES		**45 hours**

Books:

1. Spencer, Michael, Fundamentals of Light Microscopy, Cambridge UniversityPress, 1982.
2. Anderson, T. L., “Fracture Mechanics: Fundamentals and Applications”, 2nd Edition, CRC Press, 1995.
3. David B. Williams, C. Barry Carter, "Transmission Electron Microscopy: A Textbook for Materials Science", Springer, pub. 2009.
4. Joseph I Goldstein, Dale E Newbury, Patrick Echlin and David C Joy, "Scanning Electron Microscopy and X-Ray Microanalysis", 3^{rd} Edition, 2005.
5. B.D. Cullity and S.R. Stock, "Elements of X-Ray Diffraction" Third edition, Prentice Hall, NJ, 2001.
6. G.W.H. Hohne, W.F. Hemminger, H.-J. Flammersheim, "Differential Scanning Calorimetry", Springer, 2^{nd} rev. a. enlarged ed., 2003.
7. 'Fundamentals of light microscopy and electronic imaging' Douglas B. Murphy,2001, Wiley-Liss, Inc. USA
8. Transmission Electron Microscopy and Diffractometry of Materials, B. Fultz, and J.M. Howe, Second Edition, 2002, Springer, Germany.
9. Electron Diffraction in the Transmission Electron Microscope, P.E. Champness, 2001, Garland Science, USA.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)	PROGRAM SPECIFIC OUTCOMES (PSO)

	1	2	3	4	5	6	7	8	9	1 0	1 1	1 2	1	2	3
CO1	3	-	-	2	-	-	-	-	-	-	2	-	-	-	CO1
CO2	3	-	-	2	-	-	-	-	-	-	2	2	-	-	CO2
CO3	2	-	3	-	-	-	-	-	-	-	2	2	-	-	CO3
CO4	2	-	2	-	-	1	-	-	-	-	-	2	-	-	CO4
CO5	3	-	2	-	-	-	-	-	-	-	2	2	-	-	CO5
CO6	2	2	-	-	-	-	-	2	3	2	-	-	3	-	CO6

TECHNO INDIA UNIVERSITY
W E S T B E N G A L

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Product Development and CIM	**Subject Code:** TIU-PME-E104
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. Illustrate various manufacturing processes and apply design for manufacturability principles to optimize cost and quality
2. Assess the stages of product development, design cycles, and the balance between functionality and aesthetics for efficient product design
3. Investigate different manufacturing systems, automation techniques, and computer-integrated manufacturing for improved production efficiency.
4. Develop process planning methods and integrate Industry 4.0, artificial intelligence, and cyber-physical systems in modern manufacturing.

COURSE OUTCOME:

On completion of the course, the student will be able to:

CO1	Identify fundamental manufacturing processes and design for manufacturability principles.	K1
CO2	Summarize product development stages, design cycles, and the significance of balancing functionality and aesthetics	K2
CO3	Utilize manufacturing automation techniques and computer-integrated manufacturing concepts for process optimization.	K3
CO4	Examine group technology, classification methods, and coding systems to enhance manufacturing efficiency.	K4
CO5	Justify process planning approaches, including computer-aided process planning and production flow analysis, for improved manufacturing performance.	K5
CO6	Assess the impact of advanced technologies like artificial intelligence, cyber-physical systems, and Industry 4.0 on future manufacturing trends	K5

COURSE CONTENT :

MODULE 1:	**Manufacturing Processes and Design for Manufacturability**	**6 Hours**
Characteristics and capabilities of different manufacturing processes (casting, forming, machining, additive manufacturing, etc.), Principles of Design for Manufacturability (DFM) and its significance, Guidelines for reducing production costs, improving quality, and enhancing efficiency,Integration of design and manufacturing to optimize product performance		

MODULE 2:	Product Development and Design Cycles	8 Hours
Product Development Process: Idea generation, feasibility analysis, and concept selection, Product Planning: Market analysis, customer requirements, and product positioning, Design Cycles: Conceptual design, embodiment design, and detail design, Functional vs. Aesthetic Design: Balancing performance and appearance in engineering products		
MODULE 3:	**Manufacturing Systems & Automation**	**8 Hours**
Fundamentals of Manufacturing Systems and their classification, Job Shop, Batch Production, Mass Production, and Continuous Production, Flexible Manufacturing Systems (FMS) and Reconfigurable Manufacturing Systems (RMS), Evolution of Manufacturing Automation: Mechanization → NC/CNC → Flexible Automation → Intelligent Manufacturing, Computer-Integrated Manufacturing (CIM): Concept, components, and benefits, Role of computers in product design, production planning, and quality control		
MODULE 4:	**Group Technology and Coding Systems in Manufacturing**	**7 Hours**
Group Technology (GT): Concept, advantages, and implementation strategies,Coding Systems for Manufacturing: Part classification and coding schemes, Opitz System, MICLASS, DCLASS, and other coding methods, Application of GT in Manufacturing: Cellular Manufacturing and benefits of part family identification, Design of machine cells and workflow optimization		
MODULE 5:	**Process Planning and Computer-Aided Process Planning**	**8 Hours**
Process Planning: Definition, importance, and key steps, Approaches to Process Planning: Variant Approach: Retrieval-based planning using existing processes, Generative Approach: AI-based process planning for new parts,Computer-Aided Process Planning (CAPP): Role, architecture, and benefits,Application of Production Flow Analysis (PFA): Streamlining operations, minimizing setup time, and improving resource utilization		
MODULE 6:	**Analysis of CIM Modules and Future Trends**	**8 Hours**
Core Components of CIM: CAD/CAM, Computer-Aided Engineering (CAE), Computer-Aided Inspection (CAI), Material Handling and Robotics in CIM ERP and Supply Chain Integration: Role of CIM in modern production, Analysis of CIM Modules and Industry Applications: Case studies from automotive, aerospace, and electronics industries, Future Trends in CIM: Digital Manufacturing, Cyber-Physical Systems, AI in Manufacturing, Industry 4.0		
TOTAL LECTURES		**45 Hours**

Books:

1. "Manufacturing Engineering and Technology" – SeropeKalpakjian& Steven R. Schmid, Pearson Education
2. "Fundamentals of Modern Manufacturing: Materials, Processes, and Systems" – Mikell P. Groover, Wiley
3. "Product Design and Development" – Karl T. Ulrich & Steven D. Eppinger, McGraw Hill Education
4. "Group Technology and Cellular Manufacturing" – N. Singh, CRC Press.
5. "Production Systems and Computer-Integrated Manufacturing" – Mikell P. Groover, Pearson Education
6. "Industry 4.0: The Industrial Internet of Things" – Alasdair Gilchrist, Apress
7. "Artificial Intelligence in Manufacturing" – A. Saenz, CRC Press

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	1	2	3	4
CO1	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	2	-	-	-	-	-	-	-	-	1	-	2	-	-
CO3	3	2	-	2	-	-	-	-	-	-	2	3	-	-

CO4	2	-	2	-	-	-	-	-	-	-	3	-	-	-
CO5	2	-	-	2	-	-	-	-	-	-	2	2	-	-
CO6	2	-	2	-	-	2	-	-	-	2	-	2	-	2

TECHNO INDIA UNIVERSITY
W E S T B E N G A L

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2ndSem.
Course Title: Advanced Manufacturing Lab II	**Subject Code:** TIU-PME-L102
Contact Hours/Week: 0–0–4 (L–T–P)	**Credit**: 2

COURSE OBJECTIVE :

Enable the student to:

1. Understand CNC machining principles, tool selection, and programming techniques
2. Develop and execute G-code and M-code for CNC lathe and milling operations.
3. Apply Finite Element Method (FEM) for structural and thermal analysis in manufacturing.
4. Evaluate machining parameters and FEM simulations to optimize manufacturing processes.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Describe CNC machine setup, tooling, and safety protocols.	K1
CO2	Explain G-code and M-code programming for CNC machining.	K2
CO3	Apply CNC programming to perform turning, milling, and drilling operations.	K3
CO4	Analyze stress, strain, and deformation in machined components using FEM	K4
CO5	Evaluate thermal stress and heat distribution in manufacturing processes using FEM simulations.	K5
CO6	Design and optimize machining and FEM-based simulations for improved manufacturing efficiency..	K5

COURSE CONTENT :

EXPERIMENT 1:		**3 Hours**
Introduction to CNC Lathe and Milling Machines – Machine setup, tool selection, and safety protocols.		
Experiment 2:		**3 Hours**
CNC Lathe Programming – Writing and executing G-code and M-code for turning, facing, and tapering operations.		
Experiment 3:		**6 Hours**
CNC Milling Programming – Writing and executing G-code for pocket milling, contouring, and drilling.		
Experiment 4:		**3 Hours**
Introduction to Finite Element Method (FEM) – Basics of meshing, element selection, and boundary conditions using FEM software		
Experiment 5:		**3 Hours**
Static Structural Analysis – Simulation of stress, strain, and deformation in a machined component.		
Experiment 6:		**6 Hours**
Thermal Analysis – FEM-based simulation of heat distribution and thermal stress in a manufacturing process.		

TOTAL LECTURES	24 Hours

Books:

1. P.N. Rao, Manufacturing Technology Vol 2-Metal Cutting and Machine Tools, Tata McGraw Hill.
2. P.K. Mishra, Non-Conventional machining, Narosa Publishing House

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	2	3	4	5	6	7	8	9	10	1	2	3	4
CO1	3	-	-	2	1	-	-	-	-	-	2	-	-	-
CO2	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO3	2	2	-	3	-	-	-	-	-	-	3	2	-	-
CO4	3	-	3	2	-	-	-	-	-	-	2	3	-	-
CO5	3	-	3	-	-	2	-	-	-	-	2	3	-	-
CO6	2	2	2	-	-	2	-	-	-	2	3	3	-	-

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Seminar-II	**Subject Code:** TIU-PME-S198
Contact Hours/Week: 0-0-4 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE :

Enable the student to:

1. Identify emerging research areas in Manufacturing Science and Production Engineering.
2. Analyze technical advancements and research trends in selected topics.
3. Evaluate research gaps and challenges to propose potential dissertation topics.
4. Develop a structured seminar presentation with critical insights and problem-solving approaches.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Summarize key concepts, advancements, and industrial applications of selected research topics.	K2
CO2	Interpret recent research trends and technological innovations in Manufacturing Science and Production Engineering.	K3
CO3	Analyze fundamental principles and technical challenges in advanced manufacturing domains	K4
CO4	Evaluate knowledge gaps and propose solutions for real-world manufacturing and engineering challenges.	K5
CO5	Formulate a research-based seminar presentation with logical reasoning and structured content.	K6
CO6	Develop independent research abilities and critical thinking skills for future academic and industrial research.	K6

COURSE CONTENT:

SYLLABUS
The seminar serves as a foundation for research exploration, allowing students to present topics of interest in Manufacturing Science and Production Engineering that align with potential M.Tech dissertation areas. This initiative helps students identify their preferred specialization, understand emerging research trends, and develop problem-solving approaches. **Scope and Guidelines** Each student must select a research-oriented topic related to advanced manufacturing technologies, automation, materials, sustainability, or industrial process optimization. The topic

should be chosen based on personal interest and its potential as an M.Tech dissertation area Each student will be required to prepare and present a 30-minute seminar followed by a 10-minute Q&A session. **The presentation must include**: Introduction to the Topic – Importance, scope, and industrial applications. Technical Background – Fundamental concepts and advancements. Recent Research Trends – State-of-the-art technologies and innovations. Potential Research Gaps – Unresolved challenges and future directions. Possible Dissertation Work – How this topic can be expanded into M.Tech research. Conclusion & Q&A – Summary and audience engagement

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	2	-	-	2	-	-	-	-	-	-	2	2	-	-
CO3	2	-	3	-	-	-	-	-	-	-	3	2	-	-
CO4	2	-	3	-	-	1	-	-	-	-	3	2	-	-
CO5	-	2	-	-	-	-	-	2	3	-	-	-	3	-
CO6	2	-	2	-	-	-	-	2	2	3	2	2	2	2

Semester 3

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: M. Tech Project 1	**Subject Code:** TIU-PME-P201
Contact Hours/Week: 0-0-24 (L–T–P)	**Credit:** 12

COURSE OBJECTIVE :

Enable the student to:

1. Understand the fundamentals of research methodologies and specialization areas in Manufacturing and Production Engineering
2. Analyze existing literature to identify research gaps and justify the need for a specific research direction.
3. Develop a well-defined research problem, objectives, and hypotheses based on critical evaluation of prior studies.
4. Design an appropriate research methodology, selecting experimental, numerical, or analytical approaches for the proposed study.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Describe research methodologies and specialization areas in Manufacturing and Production Engineering.	K2
CO2	Analyze literature to identify research gaps and justify the study.	K4
CO3	Formulate a research problem, objectives, and hypotheses	K5
CO4	Design an appropriate research methodology using advanced tools.	K6
CO5	Assess the feasibility of the methodology through preliminary analysis.	K5
CO6	Communicate research progress effectively through reports and presentations..	K6

COURSE CONTENT:

SYLLABUS
Students will explore relevant literature, identify research gaps, define their problem statement, and establish the methodology for the project. 1. Introduction to Research in Mechanical Engineering - Overview of research methodologies, scope of specialization areas (Manufacturing and Production). 2. Literature Review and Research Gap Identification - Review of existing studies, critical analysis of methodologies, identification of limitations, and justification of selected research direction. 3. Problem Definition and Objective Setting - Formulating the research problem, defining objectives, and setting research hypotheses. 4. Methodology Development - Selection of experimental, numerical, or analytical methods, use of software tools (ANSYS, MATLAB, CFD, etc.), and material selection criteria.

5. Preliminary Analysis and Feasibility Study - Concept validation, initial data collection, and feasibility assessment of the chosen methodology.

6. Mid-Semester Review and Report Preparation - Progress evaluation, documentation of research findings, and initial report drafting.

7. Final Presentation & Evaluation - Submission of a detailed Interim Report, presentation before the Evaluation Board, and feedback integration for the second phase.

Deliverables for Semester 1:

Interim Report covering literature review, research gap, problem statement, objectives, and methodology.
Presentation on research progress before a panel of experts.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										**PROGRAM SPECIFIC OUTCOMES (PSO)**			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	-	-	-	-	-	-	-	2	-	-	-
CO2	2	-	3	-	-	-	-	-	-	-	3	-	-	-
CO3	2	-	-	-	-	-	-	-	-	-	2	2	-	-
CO4	2	-	2	2	-	-	-	-	-	-	2	3	-	-
CO5	2	-	2	-	-	1	-	-	-	-	2	2	-	-
CO6	-	2	-	-	-	-	-	2	3	2	-	-	3	-

Semester 4

Department of Mechanical Engineering

Program: M. Tech. in Mechanical Engineering	**Year, Semester:** 2ndYear., 4th Sem.
Course Title: M. Tech Project 2	**Subject Code:** TIU-PME-P202
Contact Hours/Week: 0-0-24 (L–T–P)	**Credit:**12

COURSE OBJECTIVE :

Enable the student to:

1. Execute experimental procedures and computational modeling for research validation.
2. Analyze experimental and simulation data to derive meaningful insights.
3. Evaluate research findings by comparing results with existing studies.
4. Create a comprehensive thesis and effectively present research contributions.

COURSE OUTCOME :

On completion of the course, the student will be able to:

CO1	Understand experimental procedures and computational techniques in research methodology.	K2
CO2	Apply appropriate experimental and numerical modeling techniques for data analysis.	K3
CO3	Analyze experimental and simulation results to extract meaningful insights.	K4
CO4	Evaluate research findings by comparingwith existing literature and performance benchmarks.	K5
CO5	Create a structured thesis report and technical documentation adhering to academic standards.	K6
CO6	Defend research outcomes effectively through presentations and technical discussions.	K6

COURSE CONTENT :

SYLLABUS
Students will conduct experiments, perform analysis, interpret results, and derive conclusions with a focus on innovative findings. 1. Experimental Setup and Implementation - Conducting planned experiments, equipment calibration, and data acquisition. 2. Computational and Analytical Modeling - Application of numerical simulations, validation of computational models using experimental data. 3. Result Analysis and Discussion - Interpretation of experimental and simulated results, comparison with existing literature, performance evaluation. 4. Conclusion and Future Scope - Summarizing key outcomes, addressing research limitations, and suggesting future extensions. 5. Final Report Preparation - Structuring the dissertation, writing technical papers, and formatting as per university guidelines.

6. Final Presentation & Viva-Voce - Project defense before an expert panel, showcasing novelty and research contributions. Deliverables for Semester 2 Final Thesis Report documenting experiments, results, discussion, and conclusions. Research Paper Submission (optional but encouraged). Project Defense & Presentation before the evaluation board.

Course Articulation Matrix:

	PROGRAM OUTCOMES (PO)										PROGRAM SPECIFIC OUTCOMES (PSO)			
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**1**	**2**	**3**	**4**
CO1	3	-	-	2	-	-	-	-	-	-	2	-	-	-
CO2	2	-	3	-	-	-	-	-	-	-	2	2	-	-
CO3	2	-	3	-	-	-	-	-	-	-	2	2	-	-
CO4	2	-	2	-	-	1	-	-	-	-	2	2	-	-
CO5	-	2	-	-	-	-	-	2	3	2	-	-	3	-
CO6	-	-	-	-	-	-	-	2	3	3	-	-	3	-