TECHNO INDIA UNIVERSITY

WEST BENGAL

CURRICULUM AND SYLLABUS

For

B. TECH

IN

MECHANICAL ENGINEERING

AY-2024-25

DEPARTMENT OF MECHANICAL ENGINEERING

CURRICULUM

SEMESTER 1

S. No.	Code	Course Title	L	T	P	C
1	TIU-ES-UCS-T11101	INTRODUCTION TO PROGRAMMING	3	0	0	3
2	TIU-BS-UMA-T11101	MATHEMATICS I	3	1	0	4
3	TIU-BS-UCH-T11101	CHEMISTRY	3	1	0	4
4	TIU-ES-UCS-L11191	BASIC COMPUTING LAB	0	0	2	1
5	TIU-ES-UCS-L11101	INTRODUCTION TO PROGRAMMING LABORATORY	0	0	3	1.5
6	TIU-BS-UCH-L11101	CHEMISTRY LAB	0	0	3	1.5
7	TIU-ES-UME-L11192/ TIU-ES-UME-L12192	WORKSHOP PRACTICE	0	0	3	1.5
8	TIU-HSM-UEN-S11191	CAREER ADVANCEMENT & SKILL DEVELOPMENT – I COMMUNICATION SKILL	2	0	0	2
9	TIU-HSM-UES-S11191	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	1
		Total				**19.5**

SEMESTER 2

S. No.	Code	Course Title	L	T	P	C
1	TIU-ES-UEE-T12101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING	4	0	0	4
2	TIU-ES-UCS-T12101	PROBLEM SOLVING USING DATA STRUCTURE	3	0	0	3
3	TIU-BS-UMA-T12101B	MATHEMATICS II B	4	0	0	4
4	TIU-BS-UPH-T12101	PHYSICS	4	0	0	4
5	TIU-ES-UME-T11101/ TIU-ES-UME-T12101	ENGINEERING MECHANICS	3	0	0	3
6	TIU-ES-UCS-L12101	PROBLEM SOLVING USING DATA STRUCTURES LAB	0	0	3	1.5
7	TIU-ES-UEE-L12101	BASIC ELECTRICAL AND ELECTRONICS ENGINEERING LAB AND SIMULATION	0	0	3	1.5
8	TIU-ES-UME-L11191/ TIU-ES-UME-L12191	ENGINEERING DRAWING AND GRAPHICS	0	0	3	1.5
9	TIU-BS-UPH-L12101	PHYSICS LAB	0	0	3	1.5
10	TIU-HSM-UEN-S12191	CAREER ADVANCEMENT & SKILL DEVELOPMENT – II COMMUNICATION SKILL	0	0	2	1
11	TIU-HSM-UES-S12191	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	1
		Total				**26**

SEMESTER 3

S. No.	Code	Subject Name	L	T	P	C
1	TIU-UME-T211	FLUID MECHANICS	3	1	0	4
2	TIU-UME-T213	THERMODYNAMICS	3	1	0	4
3	TIU-UME-T215	STRENGTH OF MATERIALS	3	1	0	4
4	TIU-UME-T217	MATERIAL SCIENCE	3	0	0	3
5	TIU-UMA-T205	TRANSFORM CALCULUS	3	0	0	3
6	TIU-UMB-T201	ENVIRONMENTAL SCIENCE	2	0	0	2
7	TIU-UME-L211	FLUID MECHANICS LAB	0	0	3	1.5
8	TIU-UME-L213	ADVANCED MANUFACTURING PROCESSES LAB	0	0	3	1.5
9	TIU-UEN-S297/ TIU-UME-S297A	CAREER ADVANCEMENT & SKILL DEVELOPMENT (FRENCH)/INTRODUCTION TO PYTHON	0	0	2	1
10	TIU-UES-S299	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	1
Total						**25**

SEMESTER 4

S. No.	Code	Subject Name	L	T	P	C
1	TIU-UME-T212	THEORY OF MACHINES	3	0	0	3
2	TIU-UME-T216	FLUID MACHINES	3	0	0	3
3	TIU-UME-T218	MANUFACTURING PROCESSES	3	1	0	4
4	TIU-UMA-T202	PROBABILITY & STATISTICS	3	0	0	3
5	TIU-UMA-T204	NUMERICAL ANALYSIS	3	0	0	3
6	TIU-UME-L200	MECHANICS OF MATERIALS LABORATORY	0	0	3	1.5
7	TIU-UME-S200	MACHINE DRAWING	0	0	3	1.5
8	TIU-UME-L216	FLUID MACHINES LAB	0	0	3	1.5
9	TIU-CASD-UEN-S298A/ TIU-CASD-UME-S298A	CAREER ADVANCEMENT AND SKILL DEVELOPMENT (FRENCH)/PROBLEM SOLVING WITH ADVANCE EXCEL AND POWER BI	0	0	2	1
10	TIU-UES-S298	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	1
Total						**22.5**

SEMESTER 5

S. No.	Code	Subject Name	L	T	P	C
1	TIU-UME-T301	HEAT TRANSFER	3	1	0	4
2	TIU-UME-T311	DESIGN OF MACHINE ELEMENTS I	3	1	0	4
3	TIU-UME-T313	DYNAMICS OF MACHINERY	3	0	0	3
4	TIU-UME-T315	CONVENTIONAL AND NON-CONVENTIONAL MACHINING TECHNOLOGY	3	1	0	4
5	TIU-UME-T317	REFRIGERATION AND AIR CONDITIONING SYSTEMS	3	0	0	3
6	TIU-UME-L307	HEAT TRANSFER LAB	0	0	3	1.5
7	TIU-UME-L309	FLUID MACHINERY LAB	0	0	3	1.5
8	TIU-UME-L311	AUTOCAD LAB	0	0	3	1.5
9	TIU-UTR-S301	CAREER ADVANCEMENT & SKILL DEVELOPMENT (SAP ERP)	3	0	0	3
10	TIU-UES-S381	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	1
Total						**26.5**

SEMESTER 6

S. No.	Code	Subject Name	L	T	P	C
1	TIU-UME-T328	THERMAL SYSTEMS	3	1	0	4
2	TIU-UME-T320	DESIGN OF MACHINE ELEMENTS II	3	1	0	4
3	TIU-UME-T330	ROBOTICS AND AUTOMATION	3	0	0	3
4	TIU-UME-T324	METROLOGY AND MECHANICAL MEASUREMENT	3	1	0	4
5	TIU-UME-T326	METAL CUTTING AND CNC MACHINES	3	0	0	3
6		PROFESSIONAL ELECTIVE I	3	0	0	3
7	TIU-UME-L324	METROLOGY AND MECHANICAL MEASUREMENT LAB	0	0	3	1.5
8	TIU-UME-L310	MODELLING AND SIMULATION USING SOLIDWORKS	0	0	3	1.5
9	TIU-CASD-UTR-S302A/ TIU-CASD-UME-S302A	CAREER ADVANCEMENT & SKILL DEVELOPMENT (SAP ERP)/PROBLEM SOLVING TECHNIQUES WITH PYTHON	0	0	2	1
10	TIU-UES-S382	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	0	2	1
Total						**26**

SEMESTER 7

S. No.	Code	Subject Name	L	T	P	C
1	TIU-UME-T413	OPERATIONS RESEARCH AND INDUSTRIAL MANAGEMENT	3	1	0	4
2	TIU-UME-T415	MECHATRONICS AND INDUSTRIAL CONTROL	3	1	0	4
3	TIU-UME-T419	BASICS OF STEAM POWER PLANT	3	0	0	3
4		Elective I	3	0	0	3
5	TIU-UME-L403	INDUSTRIAL TRAINING	0	0	0	1.5
6	TIU-UME-P403	B. TECH PROJECT I	0	0	3	1.5
7	TIU-UME-S409	CAREER ADVANCEMENT & SKILL DEVELOPMENT	2	0	0	2
8	TIU-UES-S499	ENTREPRENEURSHIP SKILL DEVELOPMENT	0	2	0	2
Total						**21**

SEMESTER 8

S. No.	Code	Subject Name	L	T	P	C
1		Elective II	3	0	0	3
2		Elective III	3	0	0	3
3	TIU-UME-P404	B. Tech Project II	0	0	6	3
4	TIU-UME-S496	Grand Viva Voce	0	0	0	1.5
5	TIU-UME-S402	Career Advancement and Skill Development	2	0	0	2
6	TIU-UES-S498	Entrepreneurship Skill Development	0	2	0	2
Total						**14.5**

ELECTIVES

S. No.	Code	Subject Name	L	T	P	C
Elective I						
1	TIU-UME-E417	Computer Aided Manufacturing	3	0	0	3
2	TIU-UME-E419	Gas Dynamics	3	0	0	3
3	TIU-UME-E421	Engineering Fracture Mechanics	3	0	0	3
Elective II						
1	TIU-UME-E410	Renewable Energy Sources	3	0	0	3
2	TIU-UME-E414	Computational Fluid Dynamics	3	0	0	3
3	TIU-UME-E416	Mechanics Of Composite Materials	3	0	0	3
Elective III						
1	TIU-UME-E412	Additive Manufacturing	3	0	0	3
2	TIU-UME-E418	Pollution Control and Management	3	0	0	3
3	TIU-UME-E420	Supply Chain Management	3	0	0	3

DETAIL SYLLABUS

SEMSTER 1

TECHNO INDIA UNIVERSITY

W E S T B E N G A L

Department of Computer Science and Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Introduction to Programming	**Subject Code:** TIU-ES-UCS-T11101
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. develop algorithmic problem-solving skills and implement them in C programs.
2. apply modular programming, recursion, and data structures to create interactive C programs.
3. utilize advanced C concepts like structures, pointers, and linked lists for efficient programming.

COURSE OUTCOME :

The student will be able to:

CO1	Analyze algorithmic solutions to problems.	K4
CO2	Construct algorithms using C programming.	K3
CO3	Apply interactive input/output, arithmetic expressions, repetitions, decision-making, and arrays in programs.	K3
CO4	Organize modular C programs using functions, including recursion.	K3
CO5	Categorize programs using structures, unions, pointers, and linked lists.	K4
CO6	Utilize file input and output operations in programs.	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION TO C LANGUAGE**	**4 Hours**
Character set, Variables and Identifiers, Built-in Data Types, Variable Definition, Arithmetic operators and Expressions, Constants and Literals, Simple assignment statement, Basic input/output statement, Simple 'C' programs.		
MODULE 2:	**CONDITIONAL STATEMENTS AND LOOPS**	**6 Hours**
Decision making within a program Conditions, Relational Operators, Logical Connectives, if statement, if-else statement. Loops: while loop, do while, for loop, Nested loops, Infinite loops, switch statement, Structured Programming.		
MODULE 3:	**ARRAYS**	**6 Hours**
One dimensional arrays: Array manipulation, Searching, Insertion, and Deletion of an element from an array, finding the largest / smallest element in an array; Two dimensional arrays, Addition/ multiplication of two matrices transpose of a square matrix, Null terminated strings as array of characters, Representation sparse matrice.		
MODULE 4:	**FUNCTIONS**	**7 Hours**
Top-down approach of problem solving; Modular programming and functions; Standard Library of C functions; Prototype of a function Formal parameter list, Return Type, Function call, Block structure; Passing arguments to a Function Call by reference, Call by value, Recursive Functions, Arrays as function arguments.		
MODULE 5:	**STRUCTURES AND UNIONS**	**5 Hours**
Structure variables, Initialization, Structure assignment, Nested structure, Structures and Functions, Structures and arrays: Arrays of structures, Structures containing arrays, Unions.		

MODULE 6:	POINTERS	9 Hours
Address operators, Pointers type declaration, Pointer assignment, Pointer initialization, Pointer arithmetic, Functions and pointers, Arrays and Pointers, Pointer arrays.		
MODULE 7:	**SELF-REFERENTIAL STRUCTURES AND LINKED LISTS**	**3 Hours**
Creation of a singly connected linked list, traversing a linked list, Insertion into a linked list, Deletion from a linked list.		
MODULE 8:	**FILE PROCESSING**	**5 Hours**
Concept of Files, File opening in various modes and closing of a file, Reading from a file, writing onto a file.		
TOTAL LECTURES		**45 Hours**

Books:

1. B W Kernighan and D.M. Ritchie, The C Programming Language, Prentice Hall of India.
2. K. Venugopal and Sudeep R Prasad, Programming with C, McGraw Hill
3. R G Dromey, How to solve it by Computer, Prentice Hall in India.
4. Jones, Robin and Stewart, The Art of C Programming, Narosa Publishing House
5. A Kenneth, C Problem solving and Programming, Prentice Hall International.
6. H.Scheldt, C: The Complete Reference, 4th Edition, McGraw Hill

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	3	-	2	-	-	-	-	-	-	-	1	2	-	-
CO2	2	3	2	-	3	-	-	-	-	-	-	1	3	-	-
CO3	2	2	-	-	3	-	-	-	-	-	-	1	2	-	-
CO4	2	-	2	-	3	-	-	-	-	-	-	1	2	-	-
CO5	3	2	-	-	3	-	-	-	-	-	-	-	3	-	-
CO6	1	-	-	-	2	-	-	-	-	-	-	1	2	-	-

TECHNO INDIA UNIVERSITY

W E S T B E N G A L

Department of Mathematics

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: MATHEMATICS I	**Subject Code:** TIU-BS-UMA-T11101
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. Analyze and describe the behavior of functions of single and multiple variables, understand sequences and series.
2. Solve systems of linear equations, evaluate eigenvalues and eigenvectors of square matrices.
3. Analyzing differential equations and finding their solutions.

COURSE OUTCOME:

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

CO1	Analyze the behavior and the nature of the curve with calculus of one variable.	K4
CO2	Develop a basic understanding of functions of several variables and their properties.	K4
CO3	Investigate the solutions of system of linear equations using Determinants and Matrices.	K4
CO4	Evaluate Eigen value and vectors of square matrices.	K4
CO5	Examine the nature (viz., convergence, divergence) of sequence and series.	K4
CO6	Analyze differential equations and investigate solutions.	K4

COURSE CONTENT:

MODULE 1:	**Differential Calculus**	**12 Hours**
Differential Calculus (Functions of one variable): Rolle's theorem (statement only), Cauchy's mean value theorem (Lagrange's mean value theorem as a special case), Taylor's and Maclaurin's theorems with remainders, indeterminate forms, concavity and convexity of a curve, points of inflexion, asymptotes and curvature. Differential Calculus (Functions of several variables): Limit, continuity and differentiability of functions of several variables, partial derivatives and their geometrical interpretation, differentials, derivatives of composite and implicit functions, derivatives of higher order and their commutatively, Euler's theorem on homogeneous functions, harmonic functions, Taylor's		

expansion of functions of several variables, maxima and minima of functions of several variables – Lagrange's method of multipliers.		
MODULE 2:	**Ordinary Differential Equations**	**10 Hours**
Ordinary Differential Equations: Formation of differential equations, First order differential equations - exact, linear and Bernoulli s form, second order differential equations with constant coefficients, method of variation of parameters, general linear differential equations with constant coefficients, Euler's equations, system of differential equations.		
MODULE 3:	**Sequences and Series**	**8 Hours**
Sequences and Series: Sequences and their limits, convergence of series, comparison test, Ratio test, Root test, Absolute and conditional convergence, alternating series, Power series.		
MODULE 4:	**Matrix and Determinant**	**15 Hours**
Matrix and Determinant: Revision of matrix and determinant, rank and nullity, solutions of system of linear equations using Determinants and Matrices; Eigenvalues and eigen vectors, Cayley-Hamilton Theorem, transformation of matrices, adjoint of an operator, normal, unitary, hermitian and skew-hermitian operators, quadratic forms.		
TOTAL LECTURES		**45 Hours**

Books:

1. Higher Engineering Mathematics, B. S. Grewal
2. Advanced Engineering Mathematics, Kreyszig
3. A TextBook of Engineering Mathematics, Rajesh Pandey
4. Engineering Mathematics, B. K. Pal, K. Das

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	-	2	-	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	3	-	2	-	-	-	-	-	-	-	-	2	1	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	2	1	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	-	-	-
CO6	2	3	-	2	-	-	-	-	-	-	-	1	2	1	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Chemistry

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Chemistry	**Subject Code:** TIU-BS-UCH-T11101
Contact Hours/Week: 3-1-0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

- Impart the basic concept of thermodynamics, chemical kinetics, ionic Equilibria, electrochemistry, stereochemistry, reaction mechanism and chemical bonding and apply the concept in the relevant engineering field of studies.
- Understanding the thermodynamic concept helps in acquiring information regarding the feasibility of any processes.
- Acquire the knowledge of batteries and fuel cell by understanding the basic concepts of electrochemistry.
- Acquire the knowledge of stereochemistry and reaction mechanism helps in understanding the glimpse of the organic reaction pathways.
- Impart the knowledge of various types of bonding, energy distributions in atomic and molecular orbital makes the student easier to understand the technology based on them.

COURSE OUTCOME:

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

CO1	**Understand** the concept of chemistry (thermodynamics, chemical kinetics, ionic equilibria, electrochemistry, chemical bonding and isomerism along with reaction mechanism) and applying the same in their engineering branch of studies with a special emphasis to environment, public health and safety.	K2
CO2	**Apply** the concept of chemistry to undertake the interdisciplinary research involving the relevant engineering field of studies.	K3
CO3	**Analyze** the purity of procured chemical compounds based on the acquired knowledge of chemistry related to its physical and chemical properties, which shall in turn used as a starting material for industrial application.	K4
CO4	**Analyze** the knowledge of electrochemistry for better understanding problems related to the mechanism of energy production using electrochemical systems.	K4
	Remember the principles of chemical bonding to assess different types of molecular	

CO5	interactions present in varieties of materials and justifying the choice of materials for industrial applications for an engineering solution.	K1
CO-6:	**Understand** the basic concept of organic reaction mechanism and interpreting this concept in the practical field of industrial applications.	K2

COURSE CONTENT:

MODULE 1:	**THERMODYNAMICS**	**10 Hours**
First law of thermodynamics-system, process, Internal Energy, Enthalpy, Concept of reversible and irreversible process, mathematical form of reversible work and irreversible work, Adiabatic reversible expansion, work done in isothermal and adiabatic process, Specific heat capacity, concept of molar specific heat at constant pressure (C_p), molar heat capacity at constant volume (C_v), Relationship between C_P and C_V, Second law of thermodynamics-Carnot cycle, calculating efficiency of machines, entropy, free energy, Gibbs-Helmholtz equation, concept of spontaneous and non-spontaneous process, Maxwell relation, chemical equilibrium.		
MODULE 2:	**CHEMICAL KINETICS**	**6 Hours**
Rate of reactions, factors affecting the rate of reaction, Rate laws, order and molecularity of a reaction, half life period, mechanism of elementary and overall reaction, reversible, consecutive, and parallel reactions, steady state approximation, variation of rate constant with temperature, Arrhenius equation, collision theory, concept of energy barrier, threshold energy, activation energy		
MODULE 3:		**12 Hours**
A.	**ACID-BASE EQUILIBRIA**	**5 Hours**
Strength of acids and bases based on their dissociation constant, Brönsted-Lowry and Lewis concept of acids and bases, Ionic product of water, pH of solutions and pH indicators, Common ion effect, Salt hydrolysis, Buffer solutions, Henderson's equation, Solubility product and its applications.		
B.	**ELECTROCHEMICAL SYSTEM**	**7 Hours**
Redox reactions, conductance in electrolytic solutions, specific and molar conductivity, variations of conductivity with concentration, Kohlrausch's Law, electrolysis and law of electrolysis, Ostwald's dilution law, Electrochemical cells, electrolytic cells, EMF of a cell, Application of EMF measurements, standard electrode potential, Nernst equation and its application to chemical cells, Relation between Gibbs energy change and EMF of a cell, fuel cells.		
MODULE 4:	**CHEMICAL BONDING**	**8 Hours**
Concept of ionic bonding, ionization enthalpy, lattice energy and electro negativity and periodic trends. Covalent bond, sigma and pi bonds: the examples of formation of ammonia, nitrogen, ethene, ethyne, and carbon dioxide, Resonance, Co-ordinate or dative covalent bond: the examples of formation of oxy-acids of chlorine, Hydrogen bonding. Valence Shell Electron Pair Repulsion Theory, Hybridization and shapes of molecules, d- orbital splitting in crystal field (Oh, Td), Molecular orbital theory: Qualitative treatment of homo-nuclear diatomic molecules of first two periods, Energy level diagrams, bonding, anti bonding molecular orbital's, bond order, paramagnetism of O_2 molecule.		
MODULE 5:		
A.	**ISOMERISM AND CHIRALITY**	**3 Hours**
Definition and Classification of isomerism – Structural Isomerism, Stereo Isomerism – Geometric isomerism (Cis and Trans only), Optical isomerism, CIP rules, R,S-Configuration		
B.	**REACTION MECHANISM**	**5 Hours**
Concept of Substitution, addition and elimination reactions, concept of homolytic and heterolytic fission, concept of electrophiles and nucleophiles. Inductive, mesomeric, electrometric effects, and hyper-conjugation, leaving group, reaction media, stereo chemical implications, free radicals and polar mechanisms, Nucleophilic substitution at the saturated carbon atom- S_1, S_2, and S_i, mechanism,		

elimination reaction-E1, E2, and E_1CB mechanisms.	
TOTAL LECTURES	**44 Hours**

BOOKS:

1. S. Glasstone, Text Book of Physical Chemistry, Macmillan India Limited.
2. S. Pahari, Physical Chemistry, New Central Book Agency.
3. P. W. Atkins, Physical Chemistry, 6th Edition, Oxford Publishers.
   I. L. Finar, Organic Chemistry, Addison Wesley Longman, Inc.
4. Mark Loudon, Organic Chemistry, 4th Edition, Oxford Publishers.
5. P. C. Jain and Monica Jain, "Engineering Chemistry", Dhanpat Rai, Publishing Company, 16th Edition, 2017
6. Fundamental concept of Inorganic chemistry, volume 3, 2nd edition, by Asim Kumar Das, CBS publishers and distributors Pvt. Ltd.

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	-	-	-	2	2	-	-	-	-	-	2	-	-
CO2	2	3	-	2	-	-	-	-	-	-	-	1	3	2	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	3	-
CO4	2	2	-	2	-	-	-	-	-	-	-	-	2	3	-
CO5	3	-	-	-	-	-	-	-	-	-	-	-	2	-	1
CO6	2	2	-	-	-	-	-	-	-	-	-	-	2	2	1

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Computer Science & Engineering

Program: B.Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Basic Computing Lab	**Subject Code:**TIU-ES-UCS-L11191
Contact Hours/Week: 0–0–2	**Credit:** 1

COURSE OBJECTIVE :

Enable the student to:

1. To introduce students to the UNIX/Linux environment and familiarize them with fundamental system operations, commands, and file management techniques.
2. To develop proficiency in shell scripting and command-line utilities for automating tasks, managing processes, and handling files efficiently.
3. To provide hands-on experience with GitHub operations and debugging techniques while enhancing students' ability to work with text processing tools, redirection, and file compression in a UNIX/Linux environment.

COURSE OUTCOME :

The student will be able to:

CO1	Be Familiar with the UNIX/Linux operating system	K2
CO2	Develop proficiency in using shell commands and writing basic shell scripts.	K3
CO3	Understand file systems, process management, and user permissions.	K2
CO4	Understand basic github operations and debugging of programs	K3
CO5	Apply fundamental text processing tools and commands such as grep, find, and text editors (vi/nano) for efficient file manipulation and searching.	K4
CO6	Utilize redirection, piping, and file compression techniques to manage data effectively in a UNIX/Linux environment.	K4

COURSE CONTENT :

MODULE 1:	**INTRODUCTION TO UNIX/LINUX AND BASIC COMMANDS**	**9 Hours**
Overview of UNIX/Linux operating systems, Logging into UNIX/Linux systems, Basic system commands: ls, cd, pwd, cp, mv, rm, clear, man, who, date, cal, etc. Understanding the file system hierarchy: /, /home, /bin, /usr, /var, etc.		
MODULE 2:	**FILE AND PROCESS MANAGEMENT**	**9 Hours**

File and Directory Management: Creating, removing, and organizing files and directories, Commands: mkdir, rmdir, touch, chmod, chown, rm, find, etc. Understanding file permissions and ownership (rwx permissions, chmod command) Process Management: Viewing active processes (ps, top, htop), Controlling processes: kill, bg, fg, jobs, nice, and renice,Understanding process states: running, sleeping, zombie		
MODULE 3:	**TEXT PROCESSING AND BASIC SHELL SCRIPTING**	**9 Hours**
Text Editors (vi, nano): Creating, editing, saving, and existing files, Working with commands like grep, cat, more, less, sed, and awk Basic Shell Scripting: Writing simple shell scripts (bash), Understanding variables, loops (for, while), and conditional statements (if, elif, else), Creating automation scripts for file operations and system monitoring		
MODULE 4:	**REDIRECTION, PIPING, AND FILE COMPRESSION**	**9 Hours**
Redirection and Piping: Input/output redirection (>, >>, <) Piping (|) for command chaining File Compression and Archiving: Working with gzip, tar, zip, unzip,Creating and extracting archives for data backup		
MODULE 5:	**GITHUB BASICS AND DEBUGGING TECHNIQUES**	**9 Hours**
Using GitHub for Version Control: Setting up a GitHub repository, Basic commands: git init, git add, git commit, git push, git pull, git clone,Checking in and checking out files Debugging Techniques: Identifying and resolving errors in shell scripts, Using debugging tools (echo, set -x, gdb for C programs)		
TOTAL LAB HOURS		**45 Hours**

Books:

1. "UNIX and Linux System Administration Handbook" – Evi Nemeth, Garth Snyder, Trent R. Hein, Ben Whaley, and Dan Mackin
2. "The Linux Command Line: A Complete Introduction" – William E. Shotts Jr.
3. "Learning the bash Shell"– Cameron Newham.

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	-	-	1	-	-	-	-	-	-	1	-	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	1	-	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO4	2	-	3	-	3	-	-	-	-	-	-	1	3	-	-
CO5	2	2	-	-	3	-	-	-	-	-	-	1	3	-	2
CO6	1	-	-	-	3	-	-	-	-	-	-	2	2	-	-

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Computer Science & Engineering

Program: B.Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Introduction to Programming Laboratory	**Subject Code:**TIU-ES-UCS-L11101
Contact Hours/Week: 0–0–3	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Introduce students to the fundamentals of C programming, including syntax, data types, operators, and control structures, enabling them to write and execute basic programs.
2. Develop students' ability to analyze problems, apply algorithmic thinking, and implement solutions using decision-making constructs, loops, functions, and data structures.
3. Equip students with hands-on experience in using arrays, strings, pointers, structures, and unions, enabling them to develop efficient programs for mathematical computations, data processing, and real-world applications.

COURSE OUTCOME :

CO1	Demonstrate the ability to write, compile, and execute simple C programs using basic input-output functions, arithmetic operations, and control statements.	K2
CO2	Apply conditional statements (if-else, ternary operator, switch-case) and looping constructs (for, while, do-while) to solve mathematical and logical problems.	K3
CO3	Solve mathematical problems such as factorial, permutations & combinations, series summation, and trigonometric computations using C programming.	K3
CO4	Develop programs using arrays and strings to perform operations such as searching, sorting, frequency analysis, and string transformations.	K4
CO5	Utilize pointers, structures, and unions in C to perform complex operations such as matrix manipulations, complex number arithmetic, and data organization.	K4
CO6	Implement user-defined functions and demonstrate the ability to use memory management functions, pointers, and structures for efficient data handling.	K4

COURSE CONTENT :

MODULE 1:	**Introduction to C Programming & Basic Operations**	**6 Hours**
Writing and executing a basic C program (Hello World). Understanding Input/Output functions (printf(), scanf()). Variables, Data Types, and Memory Allocation. Arithmetic operations and simple mathematical computations		
MODULE 2:	**Control Structures & Decision Making**	**6 Hours**
Conditional statements (if-else, ternary operator, switch-case). Looping constructs (for, while, do-while). Nested control structures.		
MODULE 3:	**Functions, Recursion & Pattern Printing**	**6 Hours**
Defining and calling user-defined functions. Function parameters, return types, and recursion. Printing patterns using loops (*, numbers, alternating 0/1). Mathematical computations using recursion (Factorial, nCr).		
MODULE 4:	**Arrays & Strings**	**9 Hours**
One-dimensional and two-dimensional arrays. Searching & sorting algorithms. String operations (length, frequency analysis, conversion to uppercase/lowercase).		
MODULE 5:	**Pointers, Structures & Memory Management**	**9 Hours**
Pointer concepts and memory addresses. Pointer arithmetic and array manipulation using pointers. Structures and Unions for data organization. Dynamic memory allocation concepts.		
MODULE 6:	**Advanced Programming & Applications**	**9 Hours**
Matrix operations (Addition, Multiplication). Trigonometric function computations (sin, cos values at intervals). File handling concepts (basic read/write operations).		
TOTAL LAB HOURS		**45 Hours**

Books:

1. B W Kernighan and D.M. Ritchie, The C Programming Language, Prentice Hall of India.
2. K. Venugopal and Sudeep R Prasad, Programming with C, McGraw Hill
3. R G Dromey, How to solve it by Computer, Prentice Hall in India.

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	2	2	-	-	3	-	-	-	-	-	-	1	2	-	-
CO2	2	3	-	-	2	-	-	-	-	-	-	1	3	-	-
CO3	3	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO4	2	1	3	-	3	-	-	-	-	-	-	1	2	-	-
CO5	3	2	-	-	3	-	-	-	-	-	-	1	3	-	2
CO6	2	-	2	-	3	-	-	-	-	-	-	2	3	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Chemistry

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 1st Yr., 1st Sem.
Course Title: Chemistry Lab	**Subject Code:** TIU-BS-UCH-L11101
Contact Hours/Week: 0-0-3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE:
Enable the student to:

1.	Understand the safety procedures and follow the protocol while handling chemicals and reagents
2.	Remember the best practices of chemistry lab
3.	Understand to prepare standard operating procedure for each experiment performed
4.	Understand the basic analytical techniques, such as preparation of solutions of desired strength, standardization of solutions and analysis of concentration of the species (chemicals, metal ions, active ingredients etc.) present in unknown samples using titration and volumetric method.
5.	Analyze the result obtained after performing the experiment
6.	Identify the chemicals in terms of hazardous and non-hazardous nature and also in terms of purity

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

CO1	**Remember** the safety protocols and best practices inside a chemistry lab, nature of various types of reagents, handling, and storage.	K1
CO2	**Understand** the basic principle in estimating the pH of solution either by pH meter or conductometric analysis or Potentiometric analysis as well as the basic analytical techniques, such as preparation of solutions of desired strength, standardization of	K2

	solutions and analysis of concentration of the species (chemicals, metal ions, active ingredients etc.) present in unknown samples.	
CO3	**Apply** the concept of titration in knowing the concentration of unknown acid	K3
CO4	**Evaluate** the functional groups present in organic molecules by simple reactions.	K5
CO5	**Understand** the basics of analyzing various types of organic compounds and their properties	K2
CO6	**Evaluate** the hardness of water by performing the complexometric titration and assess the solubility of different solutes in varied solvents.	K5

COURSE CONTENT:

Experiment	Topic	Contact Hours
Experiment-1:	Acid-base titration involving normality and Molarity as a parameter of standards of solution.	3 Hours
Experiment-2:	Determination of the total hardness of water	3 Hours
Experiment-3:	Determination of the relative viscosity of glycerol solution by Ostwald viscometer.	3 Hours
Experiment-4:	Determination of the relative surface tension of glycerol solution by Stalagmometer	3 hours
Experiment-5:	pH metric and Potentiometric titration	3 hours
Experiment-6:	Qualitative analysis- identification of the following in a given salt: Cations : NH^{4+}, Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{2+}, Fe^{3+}, Zn^{2+}, Ca^{2+}, and Mg^{2+}	6 hours
Experiment-7:	Qualitative analysis- identification of the following in a given salt: Anions: CO_3^{2-}, NO_2^-, SO_3^{2-}, SO_4^{2-}, NO_3^- etc.	6 hours
Experiment-8:	Identification of the following compounds and functional groups based on observations: Aliphatic compounds: formaldehyde; ethanol; acetic acid; acetone; glucose etc.	6 hours
Experiment-9:	Identification of the following compounds and functional groups based on observations: Aromatic compounds: benzoic acid; phenol; aniline; benzaldehyde etc.	6 hours
Experiment-10:	Determination of the rate kinetic constant value of ester hydrolysis	3 hours
Experiment-11:	Separation of mixtures of organic compounds utilizing the concept of boiling point/melting point/solubility	3 hours
	Total	**45 hours**

BOOKS:

1. Hands on chemistry laboratory manual by Paradis & Jeffrey, McGraw-Hill publication
2. Experiments in physical chemistry by Garland and Crawl, McGraw-Hill publication

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	2	-	-	-	-	2	-	2	-	-	-	1	2	-	-
CO2	3	2	-	2	2	-	-	-	-	-	-	1	2	3	-
CO3	2	3	-	-	2	-	-	-	-	-	-	-	2	3	-
CO4	2	2	-	2	-	-	-	-	-	-	-	-	2	3	-
CO5	2	-	-	-	-	-	-	-	-	-	-	-	2	2	-
CO6	3	2	-	2	-	-	-	-	-	-	-	1	3	3	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:**1st Yr., 1st Sem.
Course Title: Workshop Practice	**Subject Code:** TIU-ES-UME-L11192
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

Course Objective:

Enable the students to

- Understand workshop safety and gain knowledge on different materials
- Develop proficiency in using carpentry and fitting shop
- Learn about sheet metal and welding techniques
- Understand the working principles and applications of conventional machines

Course Outcome:

CO1	Demonstrate knowledge of workshop safety and materials used in manufacturing processes.	K1
CO2	Explain the use of carpentry, fitting, and sheet metal tools, and perform basic operations.	K2
CO3	Apply various fitting and machining operations such as measuring, marking, drilling, and tapping.	K3
CO4	Analyze different welding techniques (gas, arc, soldering, brazing) and their applications.	K4
CO5	Evaluate the working principles of conventional machines like lathe, shaper, drilling, grinding, and milling.	K6
CO6	Create joints and structures using woodworking, sheet metal, and welding techniques.	K5

Laboratory Content:

Module-1	**Carpentry Shop:**	**6 hours**
	General safety precautions in workshop and introduction. Types of Indian wood used for engineering purposes; Application of timber as per their classification; Carpentry hand tools and machines; Different types of carpentry joints; Different wooden joint preparation.	

Module-2	**Fitting Shop:** **6 hours** Introduction to fitter's tools, gauges, measuring instruments etc.; Job preparation involving the following operations: measuring and marking, filing, drilling, and tapping.
Module-3	**Sheet metal shop:** **3 hours** Introduction, metals used in sheet metal work, hand tools, Sheet metal joints; Soldering.
Module-4	**Welding Shop:** **3 hours** Introduction to gas and arc welding; Soldering and brazing etc.; Welding equipment and welding materials.
Module-5	**Machine Shop:** **6 hours** Demonstration and working principles of some conventional machines, like lathe, shaper, drilling, grinding, milling machines; General idea of cutting tools of the machines.

TOTAL PRACTICALS **24 hours**

Recommended Books:

1. S. K. Hajra Choudhury, A. K. Hajra Choudhury, Nirjhar Roy, **Elements of Workshop Technology** (Vol. – I & II)
2. H S Bawa. ***Workshop Practice,*** McGraw Hill Education; 2nd edition, 2/e
3. Kannaiah, P. and K.L. Narayana (2009), **Workshop Manual**, Scitech Publishers
4. Begeman, M. L. and Amstead, B. H., **Manufacturing Process**, 8th Ed., 1987, Wiley

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	-	2	-	-	-	1	2	-	-
CO2	2	-	-	-	2	-	-	-	-	-	-	-	2	2	-
CO3	2	2	-	-	2	-	-	-	-	-	-	-	3	3	-
CO4	2	3	-	-	-	-	-	-	-	-	-	-	2	3	-
CO5	3	2	-	-	-	-	-	-	-	-	-	1	3	2	-
CO6	2	2	3	-	2	-	-	-	-	-	-	-	3	3	3

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of English

Program: B. Tech in Mechanical Engineering	**Year, Semester:**1st Year, 1st Sem
Course Title: Career Advancement & Skill Development-I Communication Skill	**Subject Code:** TIU-HSM-UEN-S11191
Contact Hours/Week: 2-0-0 (L-T-P)	**Credit:** 2

COURSE OBJECTIVE :

Enable the student to:

1. Develop English proficiency for clear, precise, and confident workplace communication.
2. Enhance practical skills in vocabulary, grammar, pronunciation, speaking, and writing.
3. Apply communication theories to improve professional and interpersonal interactions.

COURSE OUTCOME :

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

CO1	Explain fundamental communication principles and their relevance in workplace interactions.	K2
CO2	Apply grammar and language skills to construct precise and coherent spoken and written communication.	K3
CO3	Demonstrate fluency in spoken English through pronunciation drills, vocabulary building, and interactive conversations.	K4
CO4	Construct well-organized sentences, paragraphs, and linked paragraphs to enhance professional writing	K3
CO5	Develop and revise written communication by employing strategies for drafting, editing, and proofreading.	K3
CO6	Assess and refine communication skills to ensure clarity, precision, and confidence in workplace interactions.	K4

COURSE CONTENT:

MODULE 1:	**INTRODUCTION TO COMMUNICATION:** Definition of Communication, Importance of Communication in the Workplace, Introduction to Communication Theory, Elements of Effective Communication, Barriers to Communication, Verbal and Non-Verbal Communication, Role of Culture in Communication.	**5 Hours**
MODULE 2:	**LANGUAGE AND GRAMMAR SKILLS:** Fundamentals of English Grammar, Sentence Structure and Syntax, Parts of Speech, Tenses and their Usage, Common Errors in Grammar, Punctuation and Mechanics, Effective Use of Vocabulary, Word Formation and Usage, Formal vs. Informal Language.	**5 Hours**
MODULE 3:	**SPEAKING SKILLS:** Principles of Effective Speaking, Pronunciation Drills, Sounds of English: Vowels and Consonants, Stress and Intonation, Developing Conversational Skills, Speaking with Clarity and Confidence, Public Speaking Basics, Expressing Opinions and Arguments, Active Listening and Response.	**5 Hours**
MODULE 4:	**WRITING SKILLS:** The Writing Process: Planning, Drafting, Revising, Editing, Writing Effective Sentences and Paragraphs, Paragraph Development and Coherence, Formal and Informal Writing Styles, Writing Emails and Workplace Documents, Writing Reports and Memos, Common Writing Errors and How to Avoid Them	**5 Hours**
MODULE 5:	**PRACTICAL LANGUAGE APPLICATION:** Building Vocabulary through Context, Word Choice and Precision, Constructing Grammatically Correct Sentences, Exercises in Sentence Formation, Pronunciation Drills and Accent Neutralization, Role-Plays and Dialogues, Group Discussions and Debates, Writing and Structuring Paragraphs, Linking Paragraphs for Coherent Writing.	**5 Hours**
MODULE 6:	**PROFESSIONAL COMMUNICATION IN THE WORKPLACE:** Workplace Communication Etiquette, Business Correspondence, Writing Professional Emails, Preparing Presentations, Communicating in Meetings, Handling Workplace Conversations, Persuasive and Negotiation Skills, Overcoming Communication Barriers, Strategies for Effective Workplace Communication.	**5 Hours**
TOTAL LECTURES		**30 Hours**

Books:

1. Sanjay Kumar, Pushp Lata, “Communication Skills”, Oxford University Press, 2015, ISBN: 9780199457069
2. M Ashraf Rizvi, “Effective Technical Communication”, McGraw Hill Education, 2017, ISBN 9352606108
3. Steven A. Beebe, Susan J. Beebe, and Mark V. Redmond, “Interpersonal Communication: Relating to Others”, Pearson, 2013, ISBN-10: 020586273X, ISBN-13: 978-0205862733.

4. Judee K. Burgoon, Laura K. Guerrero, and Kory Floyd, “Nonverbal Communication”, Routledge, 2016, ISBN-10: 1138121348, ISBN-13: 978-1138121346.
5. Ronald B. Adler, Lawrence B. Rosenfeld, and Russell F. Proctor II, “Interplay: The Process of Interpersonal Communication”, Oxford University Press, 2017, ISBN-10: 019064625X, ISBN-13: 978-0190646257.
6. Joseph A. DeVito, “The Interpersonal Communication Book”, Pearson, 2015, ISBN-10: 0133753816, ISBN-13: 978-0133753813.
7. Sarah Trenholm and Arthur Jensen, “Interpersonal Communication”, Oxford University Press, 2013, ISBN-10: 0199827504, ISBN-13: 978-0199827503.
8. John Stewart, “Bridges Not Walls: A Book About Interpersonal Communication”, McGraw-Hill Education, 2011, ISBN-10: 0073534315, ISBN-13: 978-0073534312.
9. Pamela J. Kalbfleisch, “Interpersonal Communication: Evolving Interpersonal Relationships”, Routledge, 2013, ISBN-10: 0805816611, ISBN-13: 978-0805816619.
10. Mark L. Knapp, John A. Daly, and Frederick P. M. Boster, “Interpersonal Communication Handbook”, Sage Publications, 2011, ISBN-10: 1412974747, ISBN-13: 978-1412974745.

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	-	-	-	-	-	-	-	-	2	3	-	-	2	-	-
CO2	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
CO4	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO5	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-
CO6	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-

SEMESTER 2

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Electrical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Basic Electrical & Electronics Engineering	**Subject Code:** TIU-ES-UEE-T12101
Contact Hours/Week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. Aanalyze and describe the basic electrical quantities, circuit elements, and their voltage-current relationships.
2. Design and analyze diode circuits, transistor biasing, and operational amplifier applications.
3. Understand the operation and characteristics of semiconductor devices like diodes, BJTs, JFETs, and MOSFETs.
4. Analyzing differential working principles of single-phase transformers, including voltage transformation and regulation.

COURSE OUTCOME :

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

CO1	Understand Basic Electrical Concepts	K2
CO2	Analyze DC Electrical Networks	K4
CO3	Analyze AC Circuits and Power Systems	K4
CO4	Understand Semiconductor Devices and Applications	K2
CO5	Design and Analyze Analog Circuits	K3
CO6	Understand Transformer Principles and Applications	K2

COURSE CONTENT :

MODULE 1:	Introduction	**4 Hours**
Basic electrical quantities, Voltage, Current, Power. Basic Electrical elements: Resistance, Inductance,Capacitance. Their voltage-current relationship.Voltage and current sources.		
MODULE 2:	DC Network Analysis	**5Hours**
KCL and KVL and their applications in purely resistive circuits.Concept of linear, bilateral networks. Sourceconversion, Star-Delta conversion.		
MODULE 3:	DC Network Theorems	**5 Hours**
Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Maximum Power Transfer		

Theorem.		
MODULE 4:	Sinusoidal Steady State Analysis	**5 Hours**
Matrix and Determinant: Revision of matrix and determinant, rank and nullity, solutions ofsystem of linear equations using Determinants and Matrices; Eigenvalues and eigenvectors, Cayley-Hamilton Theorem, transformation of matrices, adjoint of an operator, normal, unitary, hermitian and skew-hermitian operators, quadratic forms.		
MODULE 5:	3-Ph circuits	**5 Hours**
Introduction to 3-Ph quantities.3-ph star and delta connection. Phasor diagram for 3-ph system, Balanced 3-phloads, measurement of 3-ph power.		
MODULE 6:	Semiconductor Devices	**5 Hours**
Energy bands in solids.Intrinsic and extrinsic semiconductors.P-N junctions. Semiconductor diodes: ZenerandVaractor diodes. Bipolar transistors (operation, characteristics).		
MODULE 7:		**4 Hours**
Diode Circuits, BJT biasing & Operation of JFET, MOSFET		
MODULE 8:	OPAMPs	**5 Hours**
Properties of an ideal and a practical OPAMP. Block diagram. Concept of Virtual Short, Inverting and Non-inverting amplifiers, Summing and Differencing amplifier, Differentiator and Integrator.		
MODULE 9:	1-Ph Transformers	**5 Hours**
Faraday's Law, EMF generation (dynamic and static), B-H curve, Construction and operation of single phasetransformer: voltage and current transformation, no-load operation, voltage regulation on resistive load.		
TOTAL LECTURES		**43Hours**

Books:

1. D. Chattopadhyay, P. C. Rakshit, Funndamentals of Electric Circuit Theory, S. Chand. Publications
2. D. Chattopadhyay, P.C. Rakshit, Electronics Fundamentals and Applications, New Age International Publisher

Supplementary Reading:

1. Salivahanan and P. Kumar**,** Circuit Theory, Vikas Publishing House
2. Kulshreshtha, Basic Electrical Engineering: Principles and Application, Tata McGraw-Hill.

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	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	2	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Computer Science and Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Problem Solving using Data Structures	**Subject Code:** TIU-ES-UCS-T12101
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit: 3**

COURSE OBJECTIVE:

Enable the student to:

1. Introduce fundamental data structures such as arrays, linked lists, stacks, queues, and trees, and their role in computational problem-solving.
2. Develop logical and analytical thinking by applying data structures to efficiently store, process, and manipulate data in various programming scenarios.
3. Enhance problem-solving abilities by selecting appropriate data structures based on efficiency, scalability, and real-world applicability.

COURSE OUTCOME:

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

CO1	Recall and describe fundamental data structures, including arrays, linked lists, stacks, queues, and trees.	K1
CO2	Explain searching and sorting techniques, along with their efficiency on different data structures.	K2
CO3	Apply array and linked list operations to solve computational problems.	K3
CO4	Implement stack and queue-based algorithms for expression evaluation and problem-solving scenarios.	K3
CO5	Examine tree-based data structures (Binary Trees, BSTs) and their traversal techniques for problem-solving.	K4
CO6	Compare different data structures based on their efficiency, scalability, and real-world applicability.	K4

COURSE CONTENT:

MODULE 1:	**BASIC CONCEPTS OF DATA REPRESENTATION**	**6 Hours**
Abstract Data Types, Fundamental and Derived Data Types, Representation, Primitive Data Structures.		
MODULE 2:	**ARRAYS**	**9 Hours**
Representation of Arrays, Single and Multidimensional Arrays, Address Calculation Using Column and Row Major Ordering, Various Operations on Arrays, Application of Arrays in Matrix Multiplication, Sparse Polynomial Representation and Addition. Solving different problems using		

Arrays: Find the missing number in an array, Rotate an array to the right by k steps by reversing the array and its sub-arrays, Move all zeros in the array to the end while maintaining the relative order of non-zero elements using a two-pointer approach.		
MODULE 3	**SEARCHING AND SORTING ON VARIOUS DATA STRUCTURES**	**6 Hours**
Sequential Search, Binary Search, Comparison-based sorting concepts, Bubble Sort, Insertion Sort, Selection Sort.		
MODULE 4	**STACKS AND QUEUES**	**9 Hours**
Representation of Stacks and Queues using Arrays and Linked List, Circular Queues. Applications of Stacks: Conversion from Infix to Postfix and Prefix Expressions, Evaluation of Postfix Expression Using Stacks. Solving different problems using stack and queue: Validates if parentheses are balanced, Finds the next greater element for each item in a stack, Implements stack operations using two queues, Reverses the elements of a queue, Implements queue operations using two stacks, Implements a circular queue, Implements queue operations using two stacks.		
Module 5	**Linked Lists**	**6 Hours**
Single Linked List, Operations on List, Polynomial Representation and Manipulation Using Linked Lists, Circular Linked Lists, Doubly Linked Lists. Solving different problems using Linked List: Reverse the order of elements in a singly linked list, Merge two linked lists into one list.		
Module 6	**Trees**	**9 Hours**
Binary Tree, Binary Search Tree, Traversal Methods: Preorder, In-Order, Post-Order Traversal (Recursive And Non-Recursive), Representation (Non-threaded and Threaded) of Trees and its Applications.		
	TOTAL LECTURE	**45 Hours**

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	-	-	1	-	-	-	-	-	-	1	2	-	-
CO2	2	3	-	-	2	-	-	-	-	-	-	1	2	-	-
CO3	2	2	-	-	3	-	-	-	-	-	-	1	3	-	-
CO4	2	-	3	-	3	-	-	-	-	-	-	1	3	-	-
CO5	3	2	-	-	2	-	-	-	-	-	-	1	2	-	-
CO6	2	3	-	-	2	-	-	-	-	-	-	2	3	-	2

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mathematics

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: MATHEMATICS II B	**Subject Code:** TIU-BS-UMA-T12101B
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. understand the basics of complex analysis.
2. understand algebraic and geometric representations of vectors and vector spaces and various operations on vector spaces.
3. solve differential equations with series solution method
4. learn the applications of the definite and indefinite integrals.

COURSE OUTCOME:

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

CO1	analyze complex functions based on analyticity, integrability along a contour, calculus of residue, etc. and its applications in engineering.	K4
CO2	develop an understanding of vector spaces and inner product spaces.	K4
CO3	identify linear transformations on vector spaces and to determine the corresponding matrix representation.	K4
CO4	determine the solution of ordinary differential equations using a series solution method.	K4
CO5	formulate some special functions, namely, Legendre and Bessel functions.	K4
CO6	develop an understanding of Integral calculus and its applications such as determining the area between two curves, the surface of revolution etc.	K4

COURSE CONTENT:

MODULE 1:	**Complex analysis**	**10 Hours**
Complex analysis: Limit, continuity, differentiability and analyticity of functions, Cauchy-Riemann equations, line integrals, Cauchy Goursat theorem (statement only), independence of path, Complex integration over a contour, Cauchy's integral formula, derivatives of analytic functions, Taylor's series, Laurent's series, Zeros and singularities, Residue theorem, evaluation of real integrals by contour integration.		
MODULE 2:	**Linear algebra**	**10 Hours**
Linear Algebra: Vector spaces over any arbitrary field, linear combination, linear dependence and independence, basis and dimension, linear transformations, matrix representation of linear transformations, linear functional, dual spaces, Inner product spaces, norms, Gram-Schmidt		

process, orthonormal bases, projections and least squares approximation.		
MODULE 3:	**Series solution of ODE**	**10 Hours**
Series solution of ODE: Review of power series, Ordinary point, regular and irregular singular point, series solution near ordinary and regular singular point. Legendre's equation and Legendre polynomials, Bessel's equation and Bessel's functions.		
MODULE 4:	**Integral calculus**	**8 Hours**
Riemann Integral, fundamental theorem of integral calculus, applications of definite integrals, improper integrals, Beta and Gamma functions, reduction formulae. Double and triple integration, change in order of integration, Jacobian and change of variables formula. Parametrization of curves and surfaces.		
MODULE 5:	**Vector calculus**	**7 Hours**
Vector fields, divergence and curl, Line integrals, Green's theorem, surface integral, Gauss and Stokes' theorems with applications.		
TOTAL LECTURES		**45 Hours**

Books:

1. Higher Engineering Mathematics, *B. S. Grewal*
2. Advanced Engineering Mathematics, *Kreyszig*
3. A Text Book of Engineering Mathematics, *Rajesh Pandey*
4. Engineering Mathematics, *B. K. Pal, K. Das*

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	-	-	-	-	-	-	-	-	-	1	3	-	-
CO2	3	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	-	-	-	-	-	-	-	-	-	-	-	2	2	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Physics

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Physics	**Subject Code:** TIU-BS-UPH-T12101
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

1. Provide a foundational understanding of basic concepts of physics.
2. Develop problem-solving skills and apply the basic concepts of physics in real-world phenomena.
3. Foster critical thinking and analytical skills in applying theoretical knowledge to practical physics problems.

COURSE OUTCOME :

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

CO1	Apply basic concepts of mechanics and acoustics	K3
CO2	Interpret the concepts of physical optics and explain the principles of lasers along with their applications.	K2
CO3	Categorize di electric and magnetic properties of materials leading to Electromagnetic laws and to analyze crystal structure	K4
CO4	Identify the basic properties of conductors, semiconductors, and insulators based on their band structure, and demonstrate their behavior using fundamental band theory concepts.	K3
CO5	Apply the principles of wave-particle duality to analyze physical phenomena followed by basic quantum mechanical calculations	K3
CO6	Classify ensembles and differentiate between classical and Quantum statistical mechanics	K4

COURSE CONTENT :

MODULE 1:	**CLASSICAL MECHANICS**	**5 Hours**
Vector Calculus- gradient of a scaler field, divergence & curl of a vector field with their physical significance; Frame of references, Mechanics of a single particle - conservative and non-conservative forces, Conservation theorems of linear momentum & angular momentum, Conservation law of energy, Potential energy function F= -grad V		
MODULE 2:	**ACCOUSTICS**	**4 Hours**
Harmonic oscillator, Damped harmonic motion – over-damped, critically damped and lightly damped oscillators; Attenuation Coefficients of a vibrating system, Forced oscillations and resonance, Mechanical and electrical analogy of forced vibration.		

MODULE 3:	**OPTICS**	**8 Hours**
Interference : Interference of electromagnetic wave, condition for constructive and destructive interferences, position of maximum and minimum on the screen (no deduction), Thin film - conditions for thin film appears bright and dark (No deductions) - Newton's ring Diffraction- Different types of diffraction, Fraunhofer diffraction at single slit (Intensity distribution curve) ,Diffraction pattern in a Multi Slits & plane diffraction grating (no deduction of the intensity for N slits is necessary), Resolving power of a grating (definition & formulae) Polarization of light: Introduction, polarization by reflection - Brewster's law, Malus Law, double refraction, Nicol Prism and its uses, Detection of plane, elliptical and circularly polarized light Lasers: Properties of laser, Spontaneous and Stimulated emission, working principle of laser production, amplification of light by population inversion, Einstein's theory of A and B coefficients; He - Ne laser , applications of lasers.		
MODULE 4:	**ELECTROMAGNETISM**	**5 Hours**
Concept of displacement current, Maxwell field equations and their physical significances, Maxwell field equations for different medium, Maxwell's wave equation & its solution for free space, Electromagnetic energy flow & pointing vector		
MODULE 5:	**QUANTUM MECHANICS**	**6 Hours**
Introduction to quantum physics, Wave nature of particles, de Broglie hypothesis, Uncertainty principle, wave functions, concept of probability & probability density, operators, Expectation values. Applications of Schrödinger equation: Schrodinger equation, elementary concepts of particle in a 1D box, quantum harmonic oscillator and Hydrogen atom problem.		
MODULE 6:	**SOLID STATE PHYSICS**	**6 Hours**
Elementary idea of crystal structure –lattice, basis ,unit cell, cubic crystal system, co-ordination number& packing factor, Bragg's law and its importance. Magnetisation- Magnetic permeability and susceptibility, Relation among B,H& M. Types of magnetic materials, Comparative study among them. Hysteresis& importance of hysteresis curve		
MODULE 7:	**STATISTICAL MECHANICS**	**5 Hours**
Qualitative ideas about phase space, macrostates and microstates, density of states, , MB, FD & BE statistics (no deduction necessary), fermions, bosons , Fermi distribution at zero and non – zero temperature.		
MODULE 8:	**SEMICONDUTOR PHYSICS**	**6 Hours**
Concept of Fermi gas & Free electron theory of metals, Effective mass of an electron & its importance: concept of hole, Classification of materials on the basis of band structure, Intrinsic and extrinsic semiconductors, Effect of temperature on an extrinsic semiconductor, Fermi energy level and its position for intrinsic and extrinsic semiconductors.		
TOTAL LECTURES		**45 Hours**

Books:

1. Introduction to Electrodynamics, David J. Griffiths, Pearson Education India Learning Private Limited
2. Introduction to Classical Mechanics, R Takwale, P Puranik, McGraw Hill Education private limited
3. Engineering Physics ,Dattuprasad Ramanlal Joshi, McGraw Hill Education private limited
4. A text book on Basic Engineering Physics, A. Chakrabarti, Chhaya prakashani private Ltd.
5. A text book on Integrated Engg. Physics, A. Chakrabarti, Chhaya prakashani private Ltd.
6. A text book on Applied Engineering Physics, Chhaya prakashani private Ltd.
7. Quantum Physics of Atoms, Molecules, Solids, Nuclei and Particles,Robert Eisberg, Robert Resnick, Wiley
8. Statistical Physics, L.D. Landau, E M.Lifshitz, Butterworth-Heinemann
9. Optics,Ghatak, McGrawHill Education India Private Limited
10. Engineering Physics , Hitendra K Malik & A K Sing, McGraw Hill Education private limited

11. Advanced Acoustics, Dr. D.P. Raychaudhuri, The new bookstall, Revised Ninth Edition, 2009
12. Concepts of Modern Physics (Sixth Edition) by Arthur Beiser (Published by McGraw-Hill).
13. Introduction to Solid State Physics (January2019) by Charles Kittel (Published by Wiley)

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	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	1	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Engineering Mechanics	**Subject Code:** TIU-ES-UME-T12101
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. understand the basics of vector mechanics and its applications in engineering mechanics
2. analyze problems in statics
3. analyze problems in dynamics of particles

COURSE OUTCOME :

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

CO1	understand the basics of vector mechanics and its application in engineering mechanics.	K2
CO2	understand different force systems and the methods of finding their resultants and to be well-versed with the conditions of equilibrium in 2D.	K2
CO3	apply the laws of static equilibrium in solving problems and perform analysis of statically determinate trusses.	K4
CO4	compute centroids of plane areas, composite areas and to be able to compute area moments of inertias and radii of gyration of plane figures.	K3
CO5	understand basic principles of kinematics of particles, plane, rectilinear and curvilinear coordinate systems and projectile motion	K3
CO6	understand basic principles of kinetics of particles leading to Newton's laws and to be able to apply the work-energy and the linear impulse-linear momentum theorems in solving typical problems	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**4 Hours**
Introduction: Fundamentals of Mechanics: Introduction to mechanics; Basic concepts – mass, space, time and force; Particles and rigid bodies; Scalars and vectors; Free, sliding, fixed and unit vectors; Addition, subtraction and multiplication of two vectors; scalar triple product and vector product of 3 vectors.		
MODULE 2:	**FORCE SYSTEMS AND EQUILIBRIUM**	**9 Hours**
Force systems: Introduction to different force systems; Composition of forces – triangle, parallelogram and polygon law of forces, and addition of two parallel forces; Resolution of forces; Moment of a force, Varignon's theorem; Couples; Force-couple system; Resultant of a force system		

Equilibrium: Force Systems & Equilibrium: Free body diagram, equilibrium conditions in 2 dimensions, equilibrium of systems involving friction.		
MODULE 3:	**STRUCTURES**	**5 Hours**
Plane Truss: Statically determinate trusses; Force analysis of a truss - method of joints, method of sections		
MODULE 4:	**DISTRIBUTED FORCES**	**7 Hours**
Distributed Forces: Line, area and volume distributions of forces; Centre of gravity; Centre of mass; Centroids of plane figures; Centroids of composite areas. Moment of Inertia: Area moment of inertia; Perpendicular and Parallel axes theorems pertaining to moment of inertia; Radius of gyration.		
MODULE 5:	**KINEMATICS OF PARTICLES**	**8 Hours**
Kinematics of Particles: Differential equations of kinematics – plane, rectilinear and curvilinear motions; Cartesian co-ordinate system; Normal and tangent co-ordinate system, projectile motion.		
MODULE 6:	**KINETICS OF PARTICLES**	**12 Hours**
Kinetics of Particles: Newton's second law of motion; Work and energy principle – gravitational potential energy, elastic potential energy, kinetic energy, power, work-energy theorem, principle of impulse and momentum.		
TOTAL LECTURES		**45 Hours**

Books:

1. J. L. Meriam and L. G. Kraige, Engineering Mechanics (Vol.1 & 2), Wiley India 2017.
2. Shames I. H., Rao G. K. M., Engineering Mechanics, Pearson, 2005.
3. Khurmi R.S. ,A Textbook of Engineering Mechanics, S. Chand, 2018.
4. Bhavikatti S. S, Engineering Mechanics, New Age International Publishers, 2021.

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	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Computer Science & Engineering

Program: B.Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Problem Solving using Data Structures Lab	**Subject Code:**TIU-ES-UCS-L12101
Contact Hours/Week: 0–0–3	**Credit:** 1.5

COURSE OBJECTIVE :

Enable the student to:

1. Develop a strong foundation in data structures and algorithms with a focus on both linear and non-linear structures.
2. Implement and analyze searching, sorting, and graph algorithms to optimize problem-solving efficiency.
3. Enhance programming skills by applying data structures in real-world applications and evaluating their complexity.
4. Understand and assess the time and space complexity of algorithms for efficient software development.

COURSE OUTCOME :

The student will be able to:

CO1	Understand fundamental data structures such as arrays, linked lists, stacks, queues, trees, and graphs along with their applications.	K2
CO2	Implement various data structures using programming techniques to efficiently store, manipulate, and retrieve data.	K3
CO3	Analyze and apply different searching and sorting algorithms to optimize problem-solving.	K4
CO4	Evaluate the time and space complexity of algorithms to improve computational efficiency.	K5
CO5	Apply data structures and algorithms to solve real-world problems and develop efficient software solutions.	K3
CO6	Explore advanced data structures and algorithmic techniques for tackling complex computing challenges.	K6

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**6 Hours**
Basic Concepts of Data Representation: Abstract Data Types, Fundamental and Derived Data Types, Representation, Primitive Data Structures.		
MODULE 2:	**ARRAY REPRESENTATION**	**6 Hours**

Arrays: Representation of Arrays, Single and Multidimensional Arrays, Address Calculation Using Column and Row Major Ordering, Various Operations on Arrays, Application of Arrays Matrix Multiplication, Sparse Polynomial Representation and Addition. Solving different problems using Arrays such as the followings: Find the missing number in an array, Rotate an array to the right by k steps by reversing the array and its sub-arrays, Move all zeros in the array to the end while maintaining the relative order of non-zero elements using a two-pointer approach.		
MODULE 3:	**SEARCHING AND SORTING TECHNIQUES**	**6 Hours**
Searching and Sorting on Various Data Structures: Sequential Search, Binary Search, Comparison based sorting concept, Bubble sort, Insertion Sort, Selection Sort.		
MODULE 4:	**STACK AND QUEUE**	**9 Hours**
Stacks and Queues: Representation of Stacks and Queues using Arrays and Linked List, Circular Queues. Applications of Stacks, Conversion from Infix to Postfix and Prefix Expressions, Evaluation of Postfix Expression Using Stacks. Solving different problems using stack and queue such as Validates if parentheses are balanced, Finds the next greater element for each item in a stack, Implements stack operations using two queues, Reverses the elements of a queue, Implements queue operations using two stacks, Implements a circular queue, Implements queue operations using two stacks.		
MODULE 5:	**LINKED LISTS**	**9 Hours**
Linked Lists: Single Linked List, Operations on List, Polynomial Representation and Manipulation Using Linked Lists, Circular Linked Lists, Doubly Linked Lists. Solving different problems using Linked List such as Reverse the order of elements in a singly linked list, Merge two linked lists into one list.		
MODULE 6:	**TREE DATA STRUCTURES AND TRAVERSALS**	**9 Hours**
Trees: Binary Tree, Binary Search Tree, Traversal Methods: Preorder, In-Order, Post-Order Traversal (Recursive And Non-Recursive), Representation (Non-threaded and Threaded) of Trees and its Applications.		
TOTAL LAB HOURS		**45 Hours**

Books:

1. "Data Structures in C" by Tanenbaum, Moshe J. & Augenstein, PhilipC
2. Gilberg and Forouzan: “Data Structure- A Pseudocode approach with C” by Thomson publication
3. “Fundamentals of Data Structure” (Schaum's Series) Tata-McGraw-Hill.
4. “Fundamentals of data structure in C” Horowitz, Sahani & Freed, Computer Science Press.
5. "Data Structures Using C" by Reema Thareja

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	-	-	2	-	-	-	-	-	-	1	2	-	-
CO2	2	-	3	-	3	-	-	-	-	-	-	1	3	-	-
CO3	3	3	-	-	2	-	-	-	-	-	-	1	2	-	-
CO4	3	3	-	-	2	-	-	-	-	-	-	2	2	-	-
CO5	2	2	3	-	3	-	-	-	-	-	-	2	3	-	2

CO6	3	-	-	2	3	-	-	-	-	-	-	2	3	-	3

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Electrical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Basic Electrical and Electronics Engineering Lab and Simulation	**Subject Code:** TIU-ES-UEE-L12101
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE :

Enable the student to:

1. introduce fundamental electrical and electronic circuit theorems and develop analytical skills for solving electrical networks.
2. familiarize students with essential circuit components, including R-L-C circuits, diodes, rectifiers, and fluorescent lamps, and their practical applications.
3. enhance hands-on laboratory skills by conducting experiments on circuit analysis, diode characteristics, and rectifier efficiency evaluation.

COURSE OUTCOME :

The student will be able to:

CO1	Identify and understand fundamental electrical and electronic circuit theorems and their applications.	K1
CO2	Explain the working principles of R-L-C circuits, diodes, rectifiers, and fluorescent lamps.	K2
CO3	Apply circuit theorems such as Superposition and Thevenin's Theorem to analyze electrical networks.	K3
CO4	Conduct experiments to measure and analyze V-I characteristics of P-N junction and Zener diodes.	K3
CO5	Evaluate the efficiency and power factor of electrical circuits, rectifiers, and fluorescent lamps.	K4
CO6	Compare different rectifier circuits and analyze their output waveforms and ripple factors.	K4

COURSE CONTENT:

Experiment 1	**Verification of Superposition Theorem**	**5 Hours**
Theoretical foundation of superposition theorem, Application in linear electrical circuits, Step-by-step circuit analysis with multiple voltage/current sources, Practical applications in circuit design, troubleshooting, and network analysis.		
Experiment 2	**Study of R-L-C Series Circuit**	**6 Hours**

Characteristics of resistance (R), inductance (L), and capacitance (C) in AC circuits, Impedance (Z) and phase angle, Voltage and current phase relationships, Leading and lagging power factor, Practical applications in circuit analysis and troubleshooting.		
Experiment 3	**Verification of Thevenin's Theorem**	**6 Hours**
Theoretical foundation of Thevenin's theorem, Converting complex circuits into Thevenin equivalent, Measuring Thevenin voltage (Vth) and resistance (Rth), Practical applications in circuit design and network analysis.		
Experiment 4	**Characteristics of Fluorescent Lamp**	**5 Hours**
Gas discharge and phosphor coating in light production, Role of starter, choke (ballast), and electrodes, Measuring voltage, current, and power consumption, Efficiency comparison with incandescent and LED lamps, Impact of inductive ballast on power factor and improvement methods, Performance comparison of electromagnetic vs. electronic ballasts, Energy savings, lifespan, and environmental concerns (mercury content).		
Experiment 5	**Familiarization with Basic Electronic Components**	**6 Hours**
Identification, specifications, and testing of R, L, and C components (Color codes), Potentiometers, switches (SPDT, DPDT, DIP), Breadboards and Printed Circuit Boards (PCBs), Active components: Diodes, BJTs, JFETs, MOSFETs, Power transistors, SCRs, LEDs.		
Experiment 6	**Study of V-I Characteristics of P-N Junction Diode in Forward Bias**	**5 Hours**
Depletion layer and barrier potential, Forward bias operation, Breakdown voltage and Peak Inverse Voltage (PIV), Knee voltage and ideal PN junction diode characteristics.		
Experiment 7	**V-I Characteristics of Zener Diode in Reverse Bias**	**6 Hours**
Depletion layer and barrier potential, Reverse bias operation, Breakdown voltage and Peak Inverse Voltage (PIV), Knee voltage and ideal Zener diode characteristics.		
Experiment 8	**Study of Half-Wave and Full-Wave Rectifier**	**6 Hours**
Half-wave and full-wave rectifiers (Center-tap and Bridge), Output waveforms and voltage regulation, Ripple factor and rectifier efficiency.		
	TOTAL LAB HOURS	**45 Hours**

Books:

1. Boylestad, R. L., & Nashelsky, L. (2015). Electronic devices and circuit theory (11th ed.). Pearson.
2. Hayt, W. H., Kemmerly, J. E., & Durbin, S. M. (2018). Engineering circuit analysis (9th ed.). McGraw-Hill Education.
3. Sedra, A. S., & Smith, K. C. (2016). Microelectronic circuits (7th ed.). Oxford University Press.
4. Malvino, A. P., & Bates, D. J. (2016). Electronic principles (8th ed.). McGraw-Hill Educatio

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	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	-	-	3	2	-	-	-	-	-	-	-	3	-	-

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

TECHNO INDIA UNIVERSITY

W E S T B E N G A L

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Engineering Drawing and Graphics	**Subject Code:** TIU-ES-UME-L12191
Contact hours/week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE :

Enable the student to:

1. Develop an understanding of the fundamental concepts and significance of engineering drawing in various engineering disciplines.
2. Acquire skills to construct and analyze engineering curves, projections of points, lines, planes, and solids.
3. Learn to interpret and create orthographic and isometric projections using conventional and computer-aided drafting techniques.
4. Gain proficiency in using drafting software for preparing accurate engineering drawings.

COURSE OUTCOME :

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

CO1	Understand the fundamental principles and scope of engineering drawing across various engineering disciplines.	K2
CO2	Demonstrate proficiency in constructing and analyzing different engineering curves.	K3
CO3	Apply projection techniques for points, lines, planes, and solids in different orientations.	K3
CO4	Develop skills to create orthographic and isometric projections accurately.	K3
CO5	Interpret and convert between pictorial, orthographic, and isometric views of objects.	K2, K3, K6
CO6	Utilize computer-aided drafting tools to create precise engineering drawings.	K6

COURSE CONTENT :

MODULE 1:	**Introduction**	**6 Hours**
Scope of Engineering Drawing in all Branches of Engineering, Uses of Drawing Instruments and Accessories, Types of Arrowheads, Lines, Dimension System, Representative Fraction, Types of Scales (plain and Diagonal Scale).		
MODULE 2:	**Engineering Curves**	**6 Hours**

Classification of Engineering Curves, Application of Engineering Curves, Constructions of Engineering Curves (Conics-ellipse; parabola; hyperbola with Tangent and Normal).		
MODULE 3:	**Projection of Points and Straight Lines**	**9 Hours**
Types of Projections - Oblique, Perspective, Orthographic and Isometric Projections; Introduction to Principal Planes of Projections, Projections of Points located in all four Quadrants; Projections of lines inclined to one of the Reference Plane and inclined to two Reference Planes.		
MODULE 4:	**Projections of Planes and Solids**	**9 Hours**
Projections of various planes (Polygonal, Circular, Elliptical shape inclined to one of the reference planes and two of the reference planes) and Projections of Solids (cube, prism, pyramid, cylinder, cone and sphere).		
MODULE 5:	**Orthographic Projections & Isometric View/Projections**	**8 Hours**
Projections on Principal Planes from Front, Top and Sides of the Pictorial view of an Object, First Angle Projection and Third Angle Projection system; Full Sectional Orthographic Views, Conversion of Orthographic Views into Isometric Projection, View or Drawing; Isometric Scale.		
MODULE 6:	**Overview of Computer Aided Drafting Tools**	**1 Hours**
Introduction to Computer Aided Drafting Software; Basic Tools; Preparation of Orthographic Projections and Isometric Views Using Drafting Software.		
TOTAL		**39 Hours**

Books:

Main Reading:
1. Jolhe, Dhananjay A, Engineering Drawing an introduction to AutoCAD, Tata McGraw-Hill.

Supplementary Reading:
N.D. Bhatt, Engineering Drawing, Charotar Publishing House Pvt. Ltd.

Online Content:
1. https://nptel.ac.in/courses/112103019
2. https://nptel.ac.in/courses/112104172

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	2	-	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	2	3	-	-	-	-	-	-	-	-	-	3	-	-
CO4	2	-	3	-	-	-	-	-	-	-	-	-	3	-	-
CO5	2	1	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	1	-	2	-	3	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Physics

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Physics Lab	**Subject Code:** TIU-BS-UPH-L12101
Contact Hours/Week: 0–0–3(L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:

1. Provide hands-on experience with experimental techniques in optics, electricity, and mechanics
2. Develop a strong understanding of the fundamental physical constants and properties of materials
3. Enhance students' problem-solving and analytical skills through real-world applications

COURSE OUTCOME:

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

CO1	Develop hands-on skills in setting up experimental apparatus and accurately measuring physical quantities.	K3
CO2	Analyze experimental data using appropriate methods, interpret results, and assess the reliability and accuracy of measurements.	K4
CO3	Correlate theoretical physics principles with experimental observations to understand real-world applications.	K5
CO4	Demonstrate the ability to troubleshoot experimental issues and make informed decisions to optimize accuracy.	K5
CO5	Document experiments systematically and effectively present results, including calculations and error analysis.	K6
CO6	Work collaboratively in a lab environment, maintaining safety protocols and contributing to group discussions and analysis.	K6

COURSE CONTENT:

EXPERIMENT : 1	**NEWTON'S RING**	**3 Hours**
Determination of wavelength of a monochromatic light by Newton's ring		
EXPERIMENT : 2	**REFRACTIVE INDEX OF WATER**	**3 Hours**

Determination of refractive index of water using travelling microscope		
EXPERIMENT : 3	**HALL COEFFICIENT OF SEMICONDUCTOR**	**3 Hours**
Determination of Hall coefficient of semiconductor		
EXPERIMENT : 4	**CAREY-FOSTER BRIDGE FOR UNKNOWN RESISTANCE**	**3 Hours**
Determine of unknown resistance using Carey-Foster bridge		
EXPERIMENT : 5	**STEFAN'S BOLTZMAN CONSTANT**	**3 Hours**
Determination of Stefan-Boltzmann constant		
EXPERIMENT : 6	**BAND-GAP OF SEMICONDUCTOR**	**3 Hours**
Determination of Band gap of a given semiconductor by four probe method		
EXPERIMENT : 7	**YOUNG'S MODULUS BY FLEXURE METHOD**	**3 Hours**
Determination of Young's modulus of elasticity of the material of a bar by the method of flexure		
EXPERIMENT : 8	**MODULUS OF RIGIDITY BY DYNAMIC METHOD**	**3 Hours**
Determination of modulus of rigidity of the material of a wire by dynamic method		
EXPERIMENT : 9	**COEFFICIENT OF VISCOSITY**	**3 Hours**
Determination of coefficient of viscosity of water by Poiseulle's capillary flow method		
EXPERIMENT : 10	**PLANCK'S CONSTANT USING PHOTOELECTRIC EFFECT**	**3 Hours**
Determination of Plank's constant using photocell		
EXPERIMENT : 11	**THERMOELECTRIC POWER**	**3 Hours**
Determination of thermoelectric power of a given thermo-couple		
Total Hours (Any seven experiments to be performed)		**21 Hours**

Books:

1. Laboratory Manual
2. Advanced Practical Physics (Volume I and II) for BSc Physics Lab, B. Ghosh & K.G Mazumdar
3. An advanced course in practical physics by D . Chattopadhyay and P.C Rakshit, New central agency(P)Ltd.

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	2	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	2	3	-	-	-	-	-	-	-	-	-	1	2	-	-
CO5	1	2	-	-	-	-	-	-	-	3	-	-	1	-	-
CO6	-	-	-	-	-	-	2	-	3	2	-	-	-	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of English

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 1st Yr., 2nd Sem.
Course Title: Career Advancement & Skill Development-II Communication Skill	**Subject Code:** TIU-HSM-UEN-S12191
Contact Hours/Week: 0-0-2 (L-T-P)	**Credit:** 1

COURSE OBJECTIVE:

Enable the student to:

1. Develop fluency in spoken and written English for clear, precise, and confident communication.
2. Train in formal writing, reports, proposals, and multimedia presentations.
3. Strengthen people skills, time management, and analytical reading for workplace success.

COURSE OUTCOME:

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

CO1	**Explain** fundamental communication principles and **assess** their relevance in workplace interactions.	K2
CO2	**Apply** grammar and language skills to **construct** precise and coherent spoken and written communication	K3
CO3	**Demonstrate** fluency in spoken English through **practicing** pronunciation drills, **developing** vocabulary, and **engaging** in interactive conversations.	K4
CO4	**Construct** well-organized sentences and paragraphs to **enhance** professional writing.	K3
CO5	**Develop** and **revise** written communication by **employing** strategies for drafting, editing, and proofreading	K3
CO6	**Assess** and **refine** communication skills to **ensure** clarity, precision, and confidence in workplace interactions.	K4

COURSE CONTENT :

MODULE 1:	**COMMUNICATION THEORY AND WORKPLACE DYNAMICS:** Definition of Communication, Communication Models, Workplace Communication Strategies, Effective Messaging, Organizational Communication, Cultural Communication, Verbal and Non-Verbal Cues, Barriers to Communication, Interpersonal and Group Communication	5 Hours
MODULE 2:	**ADVANCED LANGUAGE AND GRAMMAR PROFICIENCY:** Morphology and Syntax, Sentence Structuring, Advanced Grammar Rules, Tense Modulation, Phrasal Verbs,	5 Hours

	Modifiers, Cohesion and Coherence, Lexical Resource, Semantics, Formal vs. Informal Register	
MODULE 3:	**STRATEGIC SPEAKING AND ORAL PROFICIENCY:** Phonetics and Phonology, Pronunciation Refinement, Stress and Intonation, Articulation and Clarity, Persuasive Speaking, Argumentation and Debate, Spontaneous Speaking, Interview Techniques, Business Pitches, Active Listening Strategies	5 Hours
MODULE 4:	**PROFESSIONAL AND TECHNICAL WRITING:** Writing Process Methodologies, Text Structuring, Precision in Writing, Report Writing, Business Proposals, Formal Correspondence, Executive Summaries, Editing and Proofreading, Technical Documentation, Press Releases, Persuasive and Analytical Writing	5 Hours
MODULE 5:	**APPLIED LANGUAGE AND COMMUNICATION EXERCISES:** Lexical Expansion, Idiomatic Expressions, Context-Based Learning, Grammar in Context, Role-Plays and Simulations, Speech Analysis, Storytelling Techniques, Collaborative Writing, Dialogues, Workplace Case Studies.	5 Hours
MODULE 6:	**CORPORATE COMMUNICATION AND LEADERSHIP SKILLS:** Professional Etiquette, Negotiation Tactics, Conflict Resolution, Crisis Communication, Leadership and Persuasion, Presentation Design, Cross-Cultural Communication, Media and Public Relations, Digital Communication Ethics, High-Stakes Conversations	5 Hours

TOTAL LECTURES	**30 Hours**

Books:

1. Sanjay Kumar, Pushp Lata, "Communication Skills", Oxford University Press, 2015, ISBN: 9780199457069
2. M Ashraf Rizvi, "Effective Technical Communication", McGraw Hill Education, 2017, ISBN 9352606108
3. Sarah Trenholm and Arthur Jensen, "Interpersonal Communication", Oxford University Press, 2017, ISBN-10: 019064625X, ISBN-13: 978-0190646257
4. Claude G. Théoret, "Advanced Communication Skills: 7 Keys to Personal and Professional Growth", Independently Published, 2020, ISBN-10: 1656945618, ISBN-13: 978-1656945615..
5. Ronald B. Adler, Lawrence B. Rosenfeld, and Russell F. Proctor II, "Interplay: The Process of Interpersonal Communication", Oxford University Press, 2017, ISBN-10: 019064625X, ISBN-13: 978-0190646257.
6. Joseph A. DeVito, "The Interpersonal Communication Book", Pearson, 2015, ISBN-10: 0133753816, ISBN-13: 978-0133753813.
7. Mark L. Knapp and John A. Daly, "The SAGE Handbook of Interpersonal Communication", SAGE Publications, 2011, ISBN-10: 1412974747, ISBN-13: 978-1412974745.3.
8. John Stewart, "Bridges Not Walls: A Book About Interpersonal Communication", McGraw-Hill Education, 2011, ISBN-10: 0073534315, ISBN-13: 978-0073534312.
9. Pamela J. Kalbfleisch, "Interpersonal Communication: Evolving Interpersonal Relationships", Routledge, 2013, ISBN-10: 0805816611, ISBN-13: 978-0805816619.
10. Deborah Tannen, "Talking from 9 to 5: Women and Men at Work", William Morrow Paperbacks, 2001, ISBN-10: 0060959622, ISBN-13: 978-0060959623.

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**
CO-1	-	-	-	-	-	-	-	2	3	2	-	-	-	-	-
CO-2	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
CO-3	-	-	-	-	-	-	-	-	2	3	-	-	-	-	-
CO-4	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO-5	-	-	-	-	-	-	-	-	-	3	-	-	-	-	-
CO-6	-	-	-	-	-	-	-	2	2	3	-	-	-	-	-

SEMESTER 3

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Fluid Mechanics	**Subject Code:** TIU–UME–T211
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. understand the properties of fluids and fluid statics and fluid kinematics
2. learn important concepts of continuity equation, Bernoulli's equation for flow visualization
3. understand various flow measuring devices
4. study in detail about boundary layers in a flow

COURSE OUTCOME :

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

CO1	Understand the concept of fluid and its properties and hydrostatic forces on fluid	K2
CO2	Describe the basic laws of fluid flow and flow patterns	K2
CO3	Determine equations of motion of fluid flow and their applications in measuring devices	K4
CO4	Derive the linear and angular momentum equations for a control volume and apply the conservation equations to the viscous flows through parallel plates and pipes	K3
CO5	Gain basic concepts of boundary layer theory, flow separation and velocity profiles	K2
CO6	Develop the basic concept of ideal fluids and their behavior and the principle of dimensional analysis	K2

COURSE CONTENT :

MODULE 1:	**INTRODUCTION AND FLUID STATICS**	**4 Hours**
Definition of fluid, continuum hypothesis, different properties and classifications of fluid, Fluid Statics: pressure at a point, Pascal's law, variation of pressure within a static fluid –equation of hydrostatic pressure distribution, variation of properties in static atmosphere; measurement of pressure; hydrostatic thrust on plane and curved surfaces; buoyancy, stability of submerged and floating bodies.		
MODULE 2:	**FLUID KINEMATICS**	**5 Hours**
Preliminaries of Eulerian and Lagrangian description of fluid flow; velocity and acceleration of fluid		

particles in rectilinear and curvilinear co-ordinates; different types of flow; stream line, streak line and path line; stream filament and stream tube; principle of conservation of mass; deformation of a fluid particle; governing equation for two dimensional irrotational motion and its examples.		
MODULE 3:	**FLUID DYNAMICS**	**5 Hours**
Principle of conservation of linear momentum, Euler's equation of motion along a streamline and for unsteady three dimensional flow; derivation of Bernoulli's equation and physical significance of different terms; applications of Bernoulli's equation in flow measurement devices: stagnation tube, Pitot tube, Venturi meter, orifice meter.		
MODULE 4:	**APPLICATION OF LINEAR AND ANGULAR MOMENTUM**	**4 Hours**
Linear momentum equation, analysis of force exerted by a fluid stream on a solid boundary – jet impingement, thrust on pipe bends etc., principle of conservation of angular momentum and its applications.		
MODULE 5:	**VISCOUS INCOMPRESSIBLE FLOWS**	**8 Hours**
Characteristics of laminar and turbulent flow: Reynolds experiment, critical Reynolds number; laminar flow through pipe – Hagen Poiseuille equation. Flow through closed conduits: Darcy Weisbach equation, friction factor of closed conduits, flow through noncircular ducts, Moody's diagram and its use; minor losses – at sudden expansion, at sudden contraction, at bends, at valves and fittings etc.; analysis of simple pipe network problems. Basic concept of turbulence and turbulent flow, Dynamics of viscous flows: equation of motion for viscous flow – two-dimensional laminar flow between flat parallel plates and annulus.		
MODULE 6:	**BOUNDARY LAYER THEORY**	**7 Hours**
Concept of boundary layer, boundary layer thickness, displacement thickness, momentum thickness, growth of boundary layer; Prandtl boundary layer equations, Von Karman's momentum integral equation for a boundary layer, skin friction drag coefficient for laminar and turbulent boundary layer; boundary layer in pipe flow, friction velocity; separation of boundary layer, form drag, method of drag reduction; lift and drag on submerged bodies.		
MODULE 7:	**FLOW OF IDEAL FLUIDS**	**9 Hours**
Rotation of a fluid particle, vorticity, rotational and irrotational motion; velocity potential function, circulation, stream function, flow net; governing equation for two dimensional irrotational motion and examples; superposition of simple irrotational flows, combination of a source and a sink, Rankine half body and Rankine oval, doublet and its strength, superimposition of a uniform flow and a doublet; vortex motion; combination of a uniform flow, doublet and a free vortex, Magnus effect, Kutta-Joukowski's theorem.		
MODULE 8:	**PRINCIPLES OF PHYSICAL SIMILARITY AND DIMENSIONAL ANALYSIS**	**3 Hours**
Concept and types of physical similarity; Dimensional analysis and Buckingham Pi theorem; similarity and model studies.		
TOTAL LECTURES		**45 Hours**

Books:

1. S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines", McGraw Hill Education (India), Third Edition, 2017, ISBN: 978-0071329194.
2. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Tenth Edition, 2019, ISBN: 978-8131808153.
3. F. M. White, "Fluid Mechanics", McGraw Hill Education (India), Ninth Edition, 2022, ISBN: 978-9355322043.
4. R. W. Fox, A. T. McDonald and P. J. Pritchard, "Introduction to Fluid Mechanics", John Wiley & Sons, Eighth Edition, 2010, ISBN: 978-0470547557.

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

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Thermodynamics	**Subject Code:** TIU-UME-T213
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. Comprehend thermodynamic concepts, including systems, control volumes, properties, and equilibrium, along with the Zeroth, First, and Second Laws.
2. Evaluate air-standard, vapor power, and refrigeration cycles, incorporating entropy, exergy, and energy analysis for efficiency assessment.
3. Utilize thermodynamic principles to analyze and optimize thermal energy conversion systems, including gas-vapor mixtures and psychrometric processes.
4. Integrate theoretical knowledge with practical applications to enhance the efficiency and sustainability of thermal systems

COURSE OUTCOME :

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

CO1	Understanding Thermodynamic Principles by remembering fundamental concepts, systems, properties, and thermodynamic laws.	K1
CO2	Apply Energy Conservation to analyze heat and work interactions in closed/open systems using First Law.	K3
CO3	Analyze System Efficiency by Assessing entropy, reversibility, and energy availability using Second Law.	K4
CO4	Analyze Thermodynamic Properties by study phase behavior, property charts, and equations of state	K3
CO5	Assess Power & Refrigeration Cycles by understanding air-standard, Rankine, and refrigeration cycles for efficiency	K2
CO6	Examine Gas-Vapor Mixtures by Applying thermodynamic laws to gas-vapor mixtures and psychrometric processes.	K3

COURSE CONTENT :

MODULE 1:	**BASICS OF THERMODYNAMICS**	**6 Hours**
Microscopic and Macroscopic viewpoints in thermodynamics. Fundamental concepts of System, Control volume, State, Property, Equilibrium, Processes etc. The Zeroth law of thermodynamics: Thermal equilibrium. Temperature. Principle of thermometry. International practical temperature		

scale. Different energy forms-stored energy, energy in transition. Definitions. Heat and Work Transfer		
MODULE 2:	**FIRST LAW OF THERMODYNAMICS**	**8 Hours**
First law of Thermodynamics: Joule's experiment, Statement of First Law, Heat and work interactions, Thermodynamics work and Internal energy, Energy as property of system, First Law applicable to Closed system, Thermodynamic processes and calculation of work, Heat transfer, and internal energy, Heat as Path Function, First law applicable to open system, steady flow energy equation, Steady flow energy equation for various Steady flow devices, Unsteady state systems and Relation of Steady flow energy equation with Euler and Bernoulli's Equations, PMM-1, limitations of first law.		
MODULE 3:	**SECOND LAW OF THERMODYNAMICS AND ENTROPY**	**8 Hours**
Limitations of the first law of thermodynamics. Steadily operating systems − Heat engine, Heat Pump and refrigerator. Thermal efficiency. Coefficient of Performance. Carnot cycle. Statements of the second law of thermodynamics. Equivalence of Kelvin Planck and Clausius statements of the second law of thermodynamics. Corollaries. Entropy. Reversibility and Irreversibility. Second law analysis of control volume. Entropy generation. Reversible work. Availability. Irreversibility		
MODULE 4:	**PROPERTIES OF PURE SUBSTANCES**	**6 Hours**
Thermodynamics properties of pure substances in solid, liquid and vapour phases. P-V-T behaviour simple compressible substances. Phase rule. State postulate. Thermodynamic property tables and charts. Ideal and Real gases. Equations of state. Compressibility factor. Generalized compressibility chart. Problems T-ds relations. Maxwell equations. Clapeyron equation, Clausius Clapeyron equation. Joule-Thompson coefficient. Compressibility and expansion coefficient.		
MODULE 5:	**THERMODYNAMIC CYCLES**	**12 Hours**
Carnot cycle, Air Standard Cycles Otto, Diesel, Dual, Sterling, and Brayton cycles. Gas turbine cycles with intercooling, reheating and regeneration. Use of air tables for gas power cycle analysis. Rankine cycle, Reheat cycle, Availability analysis of cycles. Refrigeration Cycles: Vapour Compression Refrigeration cycles, Vapour Absorption Refrigeration cycles, P-h chart, Air Refrigeration cycle		
MODULE 6:	**THERMODYNAMICS OF MIXTURES**	**4 Hours**
Thermodynamics of Mixtures: Mixture of ideal gases, Mixture of ideal gas and vapour, Laws of thermodynamics for gas-vapour mixtures, Psychometrics, Thermodynamic analysis of psychometric processes, Thermodynamic relations for multi-component systems.		
TOTAL LECTURES		**44 Hours****

Books:

1. Engineering Thermodynamics by P. K. Nag, McGraw Hill Education.
2.Thermodynamics: An Engineering Approach by Y.A. Cengel and M.A. Boles, McGraw Hill Education (India) Private Limited.
3.Fundamentals of Thermodynamics by C. Borgnakke and R.E. Sonntag, John Wiley and Sons.
4.Fundamentals of Engineering Thermodynamics by M. J. Moran and H. N. Shapiro, Wiley India Pvt. Ltd.

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	3	-	-	-	-	-	-	-	-	-	-	2	-	-

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

TECHNO INDIA UNIVERSITY

W E S T B E N G A L

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Strength of Materials	**Subject Code:** TIU-UME-T215
Contact hours/week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. understand the basic concepts of the stresses and strains for different materials.
2. understand the behavior of beams subjected to shear loads.
3. analyse and understand principal stresses due to the combination of two dimensional stresses on an element and failure mechanisms in materials.
4. evaluate the behavior of torsional members, columns and struts.

COURSE OUTCOME :

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

CO1	Grasp the fundamental concepts in Strength of Materials and apply them in the analysis of problems in Structural Mechanics.	K2
CO2	Determine the forces, moments, stresses and deflections which arise in basic structural members like bars, beams, shafts, columns.	K3
CO3	To analyze the thin-walled pressure vessels of cylindrical and spherical Geometries under circumferential and radial loading.	K4
CO4	Understand the concepts of principal stresses and strains which arise because of coordinate transformation.	K2
CO5	Analyze the stresses developed in various members under the action of combined axial, bending and torsional loadings.	K4
CO6	Create new ideas and apply them in the field of Solid Mechanics and Design.	K3

COURSE CONTENT:

MODULE 1:	**EQUILIBRIUM OF A DEFORMABLE BODY**	**9 Hours**
Surface and body forces, equations of equilibrium, internal resultant loadings, shear, normal and axial forces, state of stress at a point, shear and normal stresses, stress tensor, average normal and shear stresses, allowable state design, factor of safety. Deformation, normal and shear strain, small strain analysis, strain tensor. Tension-compression test, stress-strain diagram, true stress and engineering stress, stress-strain behavior of ductile and brittle materials, Hooke's law for normal and shear stresses, Poisson's ratio, strain energy, resilience and toughness. Elastic deformation of an axially loaded member, principle of superposition, statically indeterminate axially loaded members, force method of analysis		
MODULE 2:	**TORSIONAL DEFORMATION OF A CIRCULAR SHAFT**	**5 Hours**

Torsion formula, solid and hollow circular members, power transmission and shaft design, angle of twist, statically indeterminate torque-loaded members, thin-walled tubes.		
MODULE 3:	**SHEAR AND BENDING MOMENT IN BEAMS**	**6 Hours**
SFD & BMD, beam sign convention, differential relations between shear, bending moment and intensity of distributed loading, bending deformation of a straight member, the flexure formula, composite beams, reinforced concrete beam, curved beams, Shear in straight members, the transverse shear formula, limitations of the formula, shear flow in built-up members, shear centre.		
MODULE 4:	**PLANE-STRESS TRANSFORMATION**	**6 Hours**
General equations, principal stresses and planes, maximum in-plane shear stress, Mohr's circle for plane stress and its graphical construction. Plane strain transformation: general equations, principal strains and planes, maximum in-plane shear strains, Mohr's circle of plane strain, strain rosette.		
MODULE 5:	**THIN-WALLED PRESSURE VESSELS**	**3 Hours**
State of stress caused by combined loadings, namely, axial-bending, torsion-bending, axial-torsion-bending.		
MODULE 6:	**THE ELASTIC CURVE**	**6 Hours**
moment-curvature relation, slope and displacement by direct integration, Macaulay's method of singularity functions, slope and displacement by moment-area method, principle of superposition, statically indeterminate beam analysis using direct integration method, moment-area method and method of superposition.		
MODULE 7:	**STRAIN ENERGIES IN TENSION-COMPRESSION, TORSION AND BENDING**	**5 Hours**
Castigliano's theorems and their applications to solve statically determinate and indeterminate beam problems.		
MODULE 8:	**BUCKLING OF COLUMNS**	**5 Hours**
Ideal columns with pinned supports, critical loads, columns with various types of supports,concept of effective length, eccentrically loaded columns, secant formula.		
TOTAL LECTURES		**45 Hours**

Books:

1. B. J. Goodno and J. M. Gere, "Mechanics of Materials" Cengage Learning, 2020, ISBN-13: 978-0-357-37784-0.
2. R. C. Hibbeler, "Mechanics of Materials" Pearson, 2018, ISBN 13: 978-1-292-17820-2.
3. S. Timoshenko, "Strength of Materials" CBS Publishers, 2021,ISBN-13-978-8123910307.

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	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	-	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	2	-	-	-	-	-	-	-	-	-	-	3	-	-
CO5	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO6	3	2	3	-	-	-	-	-	-	-	-	-	3	-	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:**2nd Yr., 3rd Sem.
Course Title: Material Science	**Subject Code:** TIU-UME-T217
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3
Prerequisite Course: Chemistry (TIU-UCH-T106)	

Course Objective:
Enable the students to

- Fundamental knowledge of material structures and defects
- Concept of diffusion and understanding mechanical behavior of metals
- Interpret phase diagrams, and analyze heat treatment processes
- Knowledge of microstructure of ferrous and non-ferrous alloys

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

CO1	Identify the properties of metals with respect to crystal structure and understand crystal imperfections in such structures	K2
CO2	Concepts of different diffusion mechanisms and laws	K2
CO3	Understand mechanical properties of ferrous and non-ferrous alloys and solve simple numerical	K3
CO4	Interpret binary phase diagrams, heat treatment processes of metals and solving simple problems	K3
CO5	Learn about different ferrous and non-ferrous alloys	K1
CO6	Describe the concept of sample preparation for metallographic study	K2

Course Content:

MODULE 1:	**Structure**	**7 Hours**
Introduction to materials science; Crystal system; Miller indices for directions and planes; Crystal imperfections: Characteristics of dislocations, generation of dislocations; Imperfections in crystalline solids and their role in influencing various properties.		
MODULE 2:	**Diffusion**	**4 Hours**
Diffusion in metals, Application of diffusion, Types of diffusion, Diffusion mechanisms, Fick's laws, Factors influence diffusion in metal.		
MODULE 3:	**Mechanical Properties**	**8 Hours**
Tensile and compression test, Hardness, Fracture toughness (impact test), Creep, Fatigue, brittle and		

ductile fracture of metallic materials.		
MODULE 4:	**Metals and Alloys**	**12 Hours**
Solid solutions; Gibb's phase rule; binary phase diagrams; lever rule; Invariant phase reactions; iron-carbon phase diagram; TTT and CCT diagram; Heat-treatment of steels; Recovery, re-crystallization and grain growth phenomenon; General classifications, properties and applications of alloy steels: tool steels, stainless steels, cast irons.		
MODULE 5:	**Non-ferrous materials**	**6 Hours**
Copper base alloys: brass, bronze; Aluminum base alloys: designation of Al-Alloys, Al-Cu, Al-Si alloys; Nickel base alloys.		
MODULE 6:	**Metallography**	**5 Hours**
Study of microstructure of metal sample.		
TOTAL LECTURES		**39 Hours**

Recommended Books:

Main Reading

1. Mechanical Metallurgy by G.E. Dieter, McGraw Hill.
2. Material Science and Engineering and Introduction by W. D. Callister, Wiley.
3. Principles of Materials Science by W.F. Smith, McGraw Hill.

Supplementary Reading

1. Physical Metallurgy, V. Singh, Standard Publishers.
2. The Science and Engineering of Materials by S.R. Askland and P.P. Phule, Thomson Brooks/Cole.
3. Heat Treatments: Principles and Techniques by T.V. Rajan, C.P. Sharma and A. Sharma, Prentice Hall.
4. Introduction of Materials Science for Engineers by J.F. Shackelford and M.K. Muralidhara, Pearson.

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	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	3	3	2	-	-	-	-	-	-	-	-	-	3	-	-
CO4	3	3	2	2	-	-	-	-	-	-	-	-	3	-	2
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	2	2	-	-	2	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mathematics

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Transform Calculus	**Subject Code:** TIU-UMA-T205
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. provide ideas about different transformations such as Laplace, Fourier transform
2. apply these transformations on solving differential equations such as initial value problem, boundary value problem
3. learn the concept of Fourier series.

COURSE OUTCOME:

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

CO-1:	evaluate Laplace transform, inverse Laplace transform of a function.	K4
CO-2:	apply Laplace transform in solving initial value problems.	K3
CO-3:	interpret Fourier series representation of a function, sine and cosine series representation.	K4
CO-4:	deduce the value of an integral with the help of Fourier integral theorem.	K4
CO-5:	determine Fourier transform, Fourier sine and cosine transform of a function.	K4
CO-6:	apply Fourier transform in solving various problems.	K3

COURSE CONTENT:

MODULE 1:	**Laplace Transform**	**15 Hours**
Laplace Transform, properties, Inverse, Convolution, Evaluation of some integrals by Laplace Transform, Solution to initial value problems.		
MODULE 2:	**Fourier Series**	**10 Hours**
Fourier Series: Periodic functions, Fourier series representation of a function, half range series, sine and cosine series, Fourier integral formula, Parseval's identity.		
MODULE 3:	**Fourier Transform**	**20 Hours**

Fourier Transform, Fourier sine and cosine transforms. Linearity, scaling, frequency shifting and time shifting properties. Self-reciprocity of Fourier Transform, convolution theorem. Applications to boundary value problems.
TOTAL LECTURES **45 Hours**

Books:

1. Laplace and Fourier Transforms, J. K. Goyal, K. P. Gupta, G. S. Gupta
2. Fourier series and Integral Transforms, Sreenadh S. et. Al.
3. Integral Transforms and Fourier Series, A.N. Srivastava

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	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	-	-
CO3	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO4	3	3	-	2	-	-	-	-	-	-	-	-	3	-	-
CO5	3	2	-	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	3	2	2	-	-	-	-	-	-	-	-	3	-	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 2nd Yr., 3rd Sem
Course Title: Environmental Science	**Subject Code:** TIU-UMB- T201
Contact Hours/Week: 2–0–0 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE:

- Understand the fundamentals of environmental pollution from chemical processes, including characterization of emissions and effluents, and relevant environmental regulations.
- Apply pollution prevention strategies through process modification, resource recovery, and waste minimization techniques.
- Analyze and design air and water pollution control systems, including particulate and gaseous emission control, and physical water treatment processes.
- Evaluate and implement biological treatment methods for wastewater and appropriate solid waste disposal techniques.

COURSE OUTCOME:

The students will be able to:

CO1	Sources & types of pollution, industrial emissions & effluents, environmental laws & standards	K2
CO2	Pollution prevention, waste recovery & reuse, material & energy balance, water & emission control	K3
CO3	Selection & design of particulate and gaseous emission control systems, equipment performance analysis	K4
CO4	Wastewater treatment principles, solids removal processes (sedimentation, filtration, coagulation, etc.)	K4
CO5	Biological treatment principles, biochemical kinetics, aeration & sludge separation design	K4
CO6	Solid waste disposal methods, briquetting & gasification	K4

COURSE CONTENT:

MODULE 1:	**INTRODUCTION**	**10 Hours**
Environment and environmental pollution from chemical process industries, characterization of emission and effluents, environmental Laws and rules, standards for ambient air, noise emission		

and effluents.		
MODULE 2:	**POLLUTION PREVENTION**	**8 Hours**
Process modification, alternative raw material, recovery of by co-product from industrial emission effluents, recycle and reuse of waste, energy recovery and waste utilization. Material and energy balance for pollution minimization. Water use minimization, Fugitive emission/effluents and leakages and their control-housekeeping and maintenance.		
MODULE 3:	**AIR POLLUTION CONTROL**	**9 Hours**
Particulate emission control by mechanical separation and electrostatic precipitation, wet gas scrubbing, gaseous emission control by absorption and adsorption, Design of cyclones, ESP, fabric filters and absorbers		
MODULE 4:	**WATER POLLUTION CONTROL**	**9 Hours**
Physical treatment, pre-treatment, solids removal by setting and sedimentation, filtration centrifugation, coagulation and flocculation.		
MODULE 5:	**BIOLOGICAL TREATMENT**	**5 Hours**
Anaerobic and aerobic treatment biochemical kinetics, trickling filter, activated sludge and lagoons, aeration systems, sludge separation and drying.		
MODULE 6:	**SOLID DISPOSAL**	**4 Hours**
Solids waste disposal - composting, landfill, briquetting / gasification and incineration.		
	TOTAL LECTURES	**45 Hours**

Books:

1. A. K. De, "Environmental Chemistry", New Age
2. G. M. Masters, "Introduction to Environmental Engineering and Science", Pearson 3. G. S. Sodhi, "Fundamental Concepts of Environmental Chemistry", Narosa
3. E. Odum, M. Barrick& G. W. Barrett, "Fundamentals of Ecology", Brooks

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	-	-	-	3	3	2	-	-	-	2	3	-	-
CO2	3	3	3	2	2	3	2	-	-	-	-	2	3	2	-
CO3	3	3	3	3	2	2	-	-	-	-	-	2	3	2	-
CO4	3	2	2	3	-	2	-	-	-	-	-	2	2	2	-
CO5	3	3	3	3	2	2	-	-	-	-	-	2	3	2	-

CO6	3	2	2	2	2	2	3	2	-	-	-	2	3	2	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Fluid Mechanics Lab	**Subject Code:** TIU-UME-L211
Contact Hours/Week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE :

Enable the student to:

correlate the classical experiments related to fluid mechanics theory

COURSE OUTCOME :

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

CO1	Implement Bernoulli's theorem for steady flow through pipes	K3
CO2	Understand the knowledge about the fluid motion and be able to distinguish between them based on the Reynolds number	K2
CO3	Analyse the flow through the Venturi meter	K4
CO4	Analyse the flow through the Orifice meter	K4
CO5	Distinguish and analyse the flow through Rectangular and V-notch	K4
CO6	Understand the concept of various types of losses that occur in flow through pipes	K2

COURSE CONTENT :

MODULE 1:	**BERNOULLI'S EQUATION**	**3 Hours**
Verification of Bernoulli's Equation		
MODULE 2:	**REYNOLD'S EXPERIMENT**	**3 Hours**
Determination of Reynold's number for laminar and turbulent flow through pipes		
MODULE 3:	**VENTURI-METER**	**3 Hours**
Determination of the co-efficient of Discharge of Venturi-meter		
MODULE 4:	**ORIFICE-METER**	**3 Hours**
Determination of the co-efficient of Discharge of Orifice-meter		
MODULE 5:	**FRICTION OF FLUID**	**3 Hours**
Determination of the co-efficient of friction of fluid flowing through the pipes		
MODULE 6:	**TRIANGULAR NOTCH**	**3 Hours**
Determination of the co-efficient of discharge through Triangular Notch		
MODULE 7:	**RECTANGULAR NOTCH**	**3 Hours**
Determination of the co-efficient of discharge through Rectangular Notch		

TOTAL LECTURES	21 Hours

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	2	3	-	-	-	-	-	-	-	2	3	2	-
CO2	3	3	-	2	-	-	-	-	-	-	-	2	2	2	-
CO3	3	3	3	3	-	-	-	-	-	-	-	2	3	2	-
CO4	3	3	3	3	-	-	-	-	-	-	-	2	3	2	-
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	2	-
CO6	3	3	2	3	-	-	-	-	-	-	-	2	3	2	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Advanced Manufacturing Processes Lab	**Subject Code:** TIU-UME-L213
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE :

Enable the student to:

1. Analyze the construction and working principles of various conventional and nonconventional machining as lathe, shaper, EDM, abrasive jet, and ultrasonic machining processes.
2. Perform step turning, facing, plain turning, and taper turning operations on a lathe with precision.
3. Compare conventional and non-conventional machining techniques based on material removal mechanisms and process efficiency.
4. Evaluate machining parameters to optimize surface finish, accuracy, and overall performance in various machining operations.

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**	**11**	**12**	**1**	**2**	**3**
CO1	3	2	3	2	2	-	-	-	-	2	-	2	3	2	2
CO2	3	3	3	3	2	-	-	-	-	2	-	2	3	3	2
CO3	3	3	2	3	2	-	-	-	-	2	-	2	3	3	2
CO4	3	3	3	3	3	-	-	-	-	2	-	2	3	2	3
CO5	3	3	2	3	3	-	-	-	-	2	-	2	3	2	3
CO6	3	3	3	3	3	-	-	-	-	2	-	2	3	3	3

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 3rd Sem.
Course Title: Career Advancement & Skill Development:Introduction to Python	**Subject Code:** TIU-UME-S297A
Contact Hours/Week: 0-0-2 (L–T–P)	**Credit:** 1

COURSE OBJECTIVES:
Enable the student to:

- Introduce fundamental programming concepts such as variables, data types, and expressions.
- Develop problem-solving skills using conditional execution, loops, and functions.
- Enhance understanding of object-oriented programming with objects, lists, and modules.
- Apply Python programming techniques to real-world computational problems.

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

CO1	Explain fundamental Python concepts such as variables, data types, expressions, and control structures.	K2
CO2	Implement conditional statements and loops to solve real-world computational problems.	K3
CO3	Analyze errors and debugging techniques in Python programs, including syntax, runtime, and logical errors.	K4
CO4	Develop and use functions, including built-in, recursive, and lambda functions, to structure programs efficiently.	K3
CO5	Compare and evaluate different data structures like lists, objects, and multidimensional lists for various applications.	K5
CO6	Design and implement Python programs using modular approaches, list comprehensions, and object-oriented techniques.	K6

COURSE CONTENT :

Module: 1		**3 Hours**
Values and Variables: Integer and string values, variables and assignment, identifiers, floating-point numbers, user input, controlling the print function, string formatting, multi-line strings.		
Module: 2		**3 Hours**
Expressions and arithmetic: expressions, mixed type expressions, operator precedence and associativity, formatting expressions, comments, errors – syntax errors, run-time exceptions, logic errors, arithmetic expressions and operators.		
Module: 3		**3 Hours**
Conditional execution: Boolean expressions, if statement, if-else statement, compound Boolean expressions, the pass statement, floating-point equality, nested conditionals, multi-way decision		

statements, multi-way versus sequential conditionals, conditional expressions, errors in conditional statements		
Module: 4		**3 Hours**
Iteration: The while statement, definite loops vs indefinite loops, the for statement, nested loops, abnormal loop termination, the break statement, the continue statement, while/else and for/else, infinite loops		
Module: 5		**3 Hours**
Using functions: functions and modules, built-in functions, standard mathematical functions, time functions, random numbers, system-specific functions, *eval* and *exec* functions, turtle graphics, other techniques for importing functions and modules		
Module: 6		**3 Hours**
More on functions: function basics, parameter passing, documenting functions, some examples of codes which involve writing functions, custom functions versus standard functions, global variables, default parameters, recursion, lambda expressions, generators, local function definitions		
Module 7:		**3 Hours**
Objects: using objects, string objects, file objects, fraction objects, turtle graphics objects, standard python objects, object mutability and aliasing		
Module 8:		**3 Hours**
Lists: using lists, list traversal, building lists, list membership, list assignment and equivalence, list bounds, slicing, list element removal, lists and functions, list methods, list comprehensions, multidimensional lists, lists versus generators		
TOTAL LECTURES		**24 Hours**

Books:

1. 1. Fundamentals of Python programming, by R.S. Halterman (draft version)
2. Introducing Python (Modern computing in simple packages), by B. Lubanovic, O'reilly.

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	-	-	2	-	-	-	-	-	-	1	2	-	-
CO2	2	3	-	-	2	-	-	-	-	-	-	1	3	-	-
CO3	2	2	-	-	3	-	-	-	-	-	-	2	2	-	-
CO4	2	-	2	-	3	-	-	-	-	-	-	2	3	-	-
CO5	2	2	-	-	3	-	-	-	-	-	-	1	2	-	2
CO6	2	-	2	-	3	-	-	-	-	-	-	2	3	-	2

SEMESTER 4

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Theory of Machines	**Subject Code:** TIU-UME-T212
Contact hours/week: 3-0-0 (L-T-P)	**Credit:** 3

COURSE OBJECTIVE :
Enable the student to:

1. Identify and enumerate different link based mechanisms with basic understanding of motion.
2. Interpret and analyse various velocity and acceleration diagrams for various mechanisms and gear mechanisms.
3. Design and evaluate the performance of different cams and followers. Understanding the concepts of different types of belt drives.

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

CO1	To get a basic knowledge of the concepts of kinematic pairs, degrees of freedom, four-bar linkage and inversions thereof and Grashoff's law of mechanisms.	K2
CO2	To be acquainted with velocity analysis of mechanisms using different concepts and methods.	K3
CO3	To be acquainted with acceleration analysis of mechanisms including Coriolis acceleration.	K3
CO4	To understand the law governing the profile of gear tooth, fundamental law of gearing, various terms related to gears, different types of gears and different types of gear trains used in the industry for power transmission.	K2
CO5	To get a broad overview of the different types of cams and their uses and to be able to draw displacement, velocity and acceleration diagrams of cams and also cam profiles for various cases.	K4
CO6	To understand the concepts of different types of belt drives, friction tensions, initial tension and centrifugal tension and the phenomenon of creep in belt drives.	K2

COURSE CONTENT :

MODULE 1:	**LINKS AND MECHANISMS**	**13 Hours**
Introduction, Kinematic link and pairs, Number of degrees of freedom for plane mechanism, Inversion of mechanisms, 4-bar linkage, Grashoff's law, space linkage, Freudenstein equation, crank & rocker mechanism, drag link mechanism, non-parallel crank linkage, automobile steering mechanism, slider-crank mechanism, swinging block mechanism, oscillating arm quick return mechanism, elliptic trammel, toggle mechanism, straight line mechanism, pantograph, universal		

joint.		
MODULE 2:	**VELOCITY ANALYSIS**	**7 Hours**
Instantaneous Centre Method, Number of I-Centers, Arnold Kennedy Theorem, Method of locating I-centers, Relative Velocity, Velocity of a point on a link by Relative velocity method, Velocities in Slider Crank Mechanism, Forces acting in mechanism, Mechanical Advantage.		
MODULE 3:	**ACCELERATION ANALYSIS**	**7 Hours**
Introduction, Acceleration diagram of a link, acceleration of a point on link, Acceleration of Slider Crank Mechanism, Coriolis component of acceleration.		
MODULE 4:	**GEARS AND GEAR TRAINS**	**7 Hours**
Law governing profile of gear tooth, analysis of tooth profile for circular and non-circular gears for fixed centre distance, interference, minimum no. of teeth, gear tooth of involute & cycloid profile, spur gear, bevel gear, rack & pinion, worm gear, differential gear train, epicyclic gear train, bevel gear differential of automobile.		
MODULE 5:	**CAM AND FOLLOWER**	**5 Hours**
Classification of cams and followers, plate cam, cylindrical cam – displacement, velocity & acceleration diagram, analytical treatment in the design of different types of cams.		
MODULE 6:	**BELT DRIVES**	**6 Hours**
open and crossed belt drives, velocity ratio and slip, crowning of pulleys, types of pulleys, law of belting, length of belt, cone pulley, ratio of friction tensions, power transmitted, centrifugal effect on belts, maximum power transmitted by a belt, initial tension, creep.		
TOTAL LECTURES		**45 Hours****

Books:

1. S.S. Rattan "Theory of Machines" , Tata McGraw Hill Education Pvt Ltd, 2014, ISBN- 978-93-5134-347-9.
2. R.S. Khurmi and J.K. Gupta "Theory of Machines", S Chand, 2020, ISBN-81-219-2524-X.
3. A. Ghosh and A.K. Mallik "Theory of Mechanisms and Machines" , Affiliated East-West Press, 1998, ISBN-9788185938936

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	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	3	2	2	-	-	-	-	-	-	-	1	3	2	-
CO3	3	3	2	2	-	-	-	-	-	-	-	1	3	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	2	3	3	2
CO5	3	3	3	2	-	-	-	-	-	-	-	2	3	3	2
CO6	3	2	2	2	-	-	-	-	-	-	-	2	3	2	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B.Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Fluid Machines	**Subject Code:** TIU-UME-T216
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. demonstrate the classical experiments in fluid machines
2. familiarize with the construction and working of turbines and pumps
3. study the performance of turbines and pumps

COURSE OUTCOME:

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

CO-1:	Explore the principles of fluid machines	K2
CO-2:	Recognize the criteria for assessing fluid machines using dimensional analysis	K3
CO-3:	Investigate and apply the principle of impulse and reaction turbines	K3
CO-4:	Gain basic knowledge of centrifugal pump and positive displacement pumps	K3
CO-5:	Develop the basic concepts of compressors, fans and blowers	K3
CO-6:	Understand different hydraulic systems	K2

COURSE CONTENT:

MODULE 1:	**INTRODUCTION**	**3 Hours**
Classification of Fluid Machines; Energy Transfer in Fluid Machines, Introductory concepts of Impulse and Reaction Machines.		
MODULE 2:	**DIMENSIONAL ANALYSIS OF FLUID MACHINES**	**7 Hours**
Unit quantities and dimensional similarity – model and prototype, specific quantities; Principle of similarity in fluid machines; Concept of specific speed.		
MODULE 3:	**HYDRAULIC TURBINES**	**7 Hours**
Impulse turbines – constructional features and characteristics (Pelton turbine and turbo impulse turbine), Design of impulse turbine; Reaction turbines – constructional features and characteristics (Francis turbine and Kaplan turbine) and design criteria; Draft tube.		
MODULE 4:	**HYDRAULIC PUMPS**	**10 Hours**
Centrifugal pump and its characteristics, Design components of centrifugal pump; Pumps in series and parallel, losses in pumps, Stodola's slip factor; NPSH, Cavitation – cause and remedies, Thoma's cavitation parameter, runaway speed; Axial Flow Pump and Reciprocating Pump.		
MODULE 5:	**COMPRESSORS, FANS AND BLOWERS**	**13 Hours**

Basic Principles and Energy Transfer in Centrifugal Compressors, Performance Characteristics of Centrifugal Compressors; Basic Principles and Energy Transfer in Axial Flow Compressors; Fans and blowers.		
MODULE 6:	**HYDRAULIC SYSTEMS**	**2 Hours**
Fluid coupling, torque converter, hydraulic lift, crane, accumulator, etc. – elementary description and performance.		
TOTAL LECTURES		**42 Hours**

Books:

1. S. K. Som, G. Biswas and S. Chakraborty, "Introduction to Fluid Mechanics and Fluid Machines", McGraw Hill Education (India), Third Edition, 2017, ISBN: 978-0071329194.
2. J. Lal, "Hydraulic Machines including Fluidics", Metropolitan Book Co., Sixth Edition, 2016, ISBN: 978-8120004405.
3. R. K. Bansal, "A Textbook of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, Tenth Edition, 2019, ISBN: 978-8131808153.
4. S. L. Dixon and C. A. Hall, "Fluid Mechanics and Thermodynamics of Turbomachinery", Butterworth-Heinemann Inc, Seventh Edition, 2013, ISBN: 978-0124159549.

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	2	1	-	-	-	-	-	-	-	2	3	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	2	3	2	-
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3	3	-
CO4	3	3	3	2	1	-	-	-	-	-	-	2	3	2	-
CO5	3	2	3	1	1	-	-	-	-	-	-	2	3	2	-
CO6	3	2	2	1	1	-	-	-	-	-	-	2	3	2	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Manufacturing Processes	**Subject Code:** TIU-UME-T218
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4
Prerequisite Course: Material Science (TIU-UME-T217)	

Course Outcome:

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

CO1	Understand various casting and mould manufacturing processes for metals	K2
CO2	Concepts of pattern design and different casting methods	K2
CO3	Gating system design and solving simple problems	K3
CO4	Explain various forming techniques for metal works (forging, rolling, sheet metal working, extrusion, drawing, etc.)	K2
CO5	Numerical on various metal forming processes (forging, rolling and extrusion)	K3
CO6	Understand various welding processes as per engineering application and explore different solid and liquid state joining processes	K4

Course Content

MODULE 1:	**Casting**	**12 Hours**
Introduction to casting, Sand casting, Pattern: types, pattern materials, allowances; Moulding machines, materials; Cores, gate, runner and riser; Moulding processes: green sand moulding, dry sand mould, CO_2 gas molding, cement-based sand molding, plaster moulding, metallic moulding, Casting defects and repair.		
MODULE-2:	**Advance Casting Processes**	**6 Hours**
Precision investment casting, shell moulding, permanent mould casting, hot and cold chamber die casting, centrifugal casting, and continuous casting.		
MODULE-3:	**Forming**	**10 Hours**
Hot and cold working; various metal forming techniques and their analysis, viz., forging, rolling, sheet metal working, extrusion, drawing, spinning, swaging, thread rolling, tube piercing etc.; Defects in metal working.		
MODULE-4:	**Welding and joining processes:**	**11 hours**
Soldering; Brazing; Fusion and non-fusion welding processes; oxy-acetylene gas welding, arc welding, and resistance welding; Welding defects and inspection; Various modern welding		

processes like Tungsten Inert Gas, Metal Inert Gas, Submerged arc welding.		
Module-5:	**Powder metallurgy**	**4 hours**
Basic idea on powder metallurgy		
TOTAL LECTURES		**45 hours**

Recommended Books:

Main Reading

1. Manufacturing Technology: Foundry, Forming and Welding by P.N. Rao, Tata McGraw Hill Education Private Limited.
2. Manufacturing Processes for Engineering Materials by S. Kalpakjian and S.R. Schmid, Pearson Education.
3. Manufacturing Science by A. Ghosh and A.K. Mallik, Wiley Eastern.

Supplementary Reading

1. Welding and Welding Technology by R.L. Little, McGraw-Hill Education (India) Pvt. Limited.
2. Principles of Manufacturing Materials and Processes by J. S. Campbell, McGraw-Hill Education (India) Pvt. Limited.
3. Production Engineering Sciences, P. C. Pandey and C. K. Singh, Standard Publishers Ltd.
4. Welding Metallurgy by G.E. Linnert, AWS. Heat Treatments: Principles and Techniques by T.V. Rajan, C.P. Sharma and A. Sharma, Prentice Hall.
5. Introduction of Materials Science for Engineers by J.F. Shackelford and M.K. Muralidhara, Pearson.

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	2	1	-	-	-	-	-	-	-	2	3	2	-
CO2	3	2	2	1	-	-	-	-	-	-	-	2	3	2	-
CO3	3	3	3	2	1	-	-	-	-	-	-	2	3	2	-
CO4	3	2	2	2	-	-	-	-	-	-	-	2	3	3	-
CO5	3	3	3	2	-	-	-	-	-	-	-	2	3	3	-
CO6	3	2	2	1	-	-	-	-	-	-	-	2	3	2	-

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mathematics

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Probability & Statistics	**Subject Code:** TIU-UMA-T202
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. understand the basics of probability and statistical analysis
2. analyze the nature of problems solved with probability distribution
3. understand basic statistics, dispersion, regression and curve fitting technique

COURSE OUTCOME:

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

CO1	To illustrate the foundations of probabilistic and statistical analysis mostly used in varied applications	K4
CO2	To investigate the probability using basic knowledge and fundamental concepts of probability.	K4
CO3	To formulate and analyze several well-known distributions, including Binomial, Poisson, Normal, Exponential Distributions etc., and understand their scope of application to real world problems	K4
CO4	To establish the basic statistical concepts and measures of central tendencies	K4
CO5	To calculate Measures of dispersion – standard deviation, variance	K4
CO6	To analyze observations in terms of regression and curve fitting	K4

COURSE CONTENT:

MODULE 1:	**PROBABILITY**	**25 Hours**
Probability: Classical, relative frequency and axiomatic definitions of probability, mutually exclusive events, independent events, conditional probability, Bayes' Theorem. Random Variables: Discrete and continuous random variables, probability mass, probability density and cumulative distribution functions, mathematical expectation, moments. Distributions: Uniform, Binomial, Geometric, Poisson, Negative binomial, Exponential, Normal distributions, Joint and marginal distribution.		
MODULE 2:	**STATISTICS**	**20 Hours**
Graphical representation of data, Frequency distributions		

Measures of central tendencies – mean, median, mode Measures of dispersion – standard deviation, variance Principle of Least Squares, curve fitting, regression analysis.	
TOTAL LECTURES	**45 Hours**

Books:

1. Ravish R Singh, Mukul Bhatt Engineering Mathematics, McGraw-Hill Education
2. N G Das, Statistical Methods, McGraw-Hill
3. Sheldon M. Ross, Introduction to Probability and Statistics for Engineers and Scientists, McGraw-Hill.

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	-	2	-	-	-	-	-	-	-	1	3	2	-
CO2	3	3	-	2	-	-	-	-	-	-	-	1	3	2	-
CO3	3	3	-	3	-	-	-	-	-	-	-	1	3	3	-
CO4	3	2	-	2	-	-	-	-	-	-	-	1	3	2	-
CO5	3	3	-	2	-	-	-	-	-	-	-	1	3	2	-
CO6	3	3	2	3	1	-	-	-	-	-	-	2	3	3	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mathematics

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Numerical Analysis	**Subject Code:** TIU-UMA-T204
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. be familiar with numerical methods of solving complicated mathematical problems
2. get idea about different errors, interpolation, integration.
3. get the concept of roots finding methods.
4. know the methods for solving simultaneous linear algebraic equations, initial value problems.

COURSE OUTCOME:

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

CO-1:	Explain the concept of error in numerical analysis such as round off errors, Truncation errors.	K2
CO-2:	Develop an idea about Newton's Forward and Backward interpolation formula, Divided Difference.	K4
CO-3:	Establish the concept of numerical differentiation and develop the idea of numerical integration using Trapezoidal and Simpson's 1/3rd rules.	K4
CO-4:	Evaluate roots of polynomial and transcendental equations by Bisection, Iteration, Newton-Raphson, Regula-Falsi methods.	K4
CO-5:	Solve simultaneous linear algebraic equations by Gauss Elimination and Gauss-Seidel iteration method.	K4
CO-6:	Interpret and evaluate initial value problems numerically using Euler, Modified Euler, Runge-Kutta methods.	K4

COURSE CONTENT:

MODULE 1:	**ERROR AND APPROXIMATION**	**3 Hours**
Approximations and round off errors, Truncation errors and Taylor Series.		
MODULE 2:	**INTERPOLATION**	**8 Hours**
Newton's Forward, Backward, Lagrange's interpolation and Divided Difference.		
MODULE 3:	**NUMERICAL DIFFERENTIATION AND INTEGRATION**	**8 Hours**
Trapezoidal, Simpson's 1/3rd rule and differentiation at the end points of a table.		
MODULE 4:	**ALGEBRAIC AND TRANSCENDENTAL EQUATIONS**	**6 Hours**
Determination of roots of polynomials and transcendental equations by Bisection, Iteration,		

Newton-Raphson, Regula-Falsi methods.		
MODULE 5:	**SOLUTION OF LINEAR EQUATIONS**	**6 Hours**
Solutions of linear simultaneous linear algebraic equations by Gauss Elimination and Gauss Seidel iteration methods.		
MODULE 6:	**NUMERICAL DIFFERENTIAL EQUATION**	**14 Hours**
Numerical solution of initial value problems by Euler, Modified Euler, Runge-Kutta method.		
TOTAL LECTURES		**45 Hours**

Books:

1. Numerical Methods: For Scientific and Engineering Computation, M. K. Jain, S. R. K. Iyengar, R. K. Jain.
2. Numerical Analysis, G. S. Rao.
3. Numerical Methods, P. Kandasamy, K. Thilagavathy, K. Gunavathi.

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	-	-	-	3	3	2	-	-	-	2	3	-	-
CO2	3	3	3	2	2	3	2	-	-	-	-	2	3	2	-
CO3	3	3	3	3	2	2	-	-	-	-	-	2	3	2	-
CO4	3	2	2	3	-	2	-	-	-	-	-	2	2	2	-
CO5	3	3	3	3	2	2	-	-	-	-	-	2	3	2	-
CO6	3	2	2	2	2	2	3	2	-	-	-	2	3	2	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:**2nd Yr., 4th Sem.
Course Title: Mechanics of Materials Laboratory	**Subject Code:** TIU-UME-L200
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5
Prerequisite Course: Physics (TIU-UPH-T104); Material Science (TIU-UME-T217); Strength of Materials (TIU-UME-T215)	

Course Objective:

Enable the students to

- impart fundamental knowledge of material properties and mechanical testing methods
- develop practical skills in using mechanical testing equipment
- analyze and interpret experimental results for material performance evaluation

Course Outcome:

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

CO1	Understand the fundamental mechanical properties of materials	K2
CO2	Analyze the compressive strength of materials	K4
CO3	Apply impact testing techniques to assess material toughness	K3
CO4	Evaluate the hardness of materials using different hardness testing methods	K5
CO5	Demonstrate the use of Rockwell Hardness testing machine	K3
CO6	Correlate mechanical properties with material behavior under different loading conditions	K6

Course Content:

EXPERIMENT NUMBER 1:		**3 Hours**
To determine the ultimate tensile strength, Young's modulus, percentage of elongation, and percentage of area reduction of mild steel.		
EXPERIMENT NUMBER 2:		**3 Hours**
To conduct compression test on a specimen using a universal testing machine (UTM) to determine ultimate compressive strength of the material.		
EXPERIMENT NUMBER 3:		**3 Hours**
To determine the impact energy absorbing characteristic of mild steel at room temperature using Izod impact test		

EXPERIMENT NUMBER 4:		**3 Hours**
To determine the impact energy absorbing characteristic of mild steel at room temperature using the Charpy impact test.		
EXPERIMENT NUMBER 5:		**3 Hours**
To determine the Brinell hardness number of the given test specimen.		
EXPERIMENT NUMBER 6:		**3 Hours**
To study the Rockwell hardness testing machine and perform the Rockwell hardness test.		
TOTAL LECTURES		**18 Hours**

Recommended Books:

1. Mechanical Metallurgy by G.E. Dieter, McGraw Hill.
2. Material Science and Engineering and Introduction by W.D. Callister, Wiley.

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	-	-	-	-	-	-	-	-	-	1	3	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	1	3	2	-
CO3	3	3	2	3	-	-	-	-	-	-	-	2	3	3	-
CO4	3	2	2	2	1	-	-	-	-	-	-	2	3	3	-
CO5	2	2	3	2	2	-	-	-	-	-	-	2	3	3	-
CO6	3	3	2	3	-	-	-	-	-	-	-	2	3	3	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Machine Drawing	**Subject Code:** TIU-UME-S200
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE :
Enable the student to:

1. Analyze the construction and nomenclature of screw threads, including metric, square, and Acme threads, along with the design and application of hexagonal and square nuts, washers, and bolts.
2. Interpret the functionality and assembly of mechanical joints such as the socket and spigot cotter joint and knuckle joint to assess their suitability in different engineering applications.
3. Interpret the functionality and assembly of mechanical joints such as the socket and spigot cotter joint and knuckle joint to assess their suitability in different engineering applications.
4. Evaluate the design and strength characteristics of riveted joints, including single and double riveted lap joints and butt joints, to determine their effectiveness in load-bearing applications.

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

CO-1:	Understand the nomenclature, classification, and applications of different screw threads, nuts, washers, and bolts used in mechanical assemblies.	K2
CO-2:	Analyze the construction and working principles of the socket and spigot cotter joint to determine its suitability for mechanical linkages	K4
CO-3:	Examine the design and functionality of the knuckle joint and its role in transmitting axial loads in mechanical systems.	K4
CO-4:	Interpret the types and symbols of welded joints, understanding their significance in structural and fabrication applications.	K3
CO-5:	Evaluate the strength and performance of riveted joints, including lap and butt joints, by assessing their efficiency in load-bearing applications.	K5
CO-6:	Apply drafting techniques to create precise engineering drawings of screw threads, mechanical joints, and fasteners following standard conventions.	K3

COURSE CONTENT :

SHEET NUMBER 1:		**6 Hours**
Screw Thread (Thread Nomenclature, Metric Thread, Square Thread, Acme Thread), Hexagonal Nut, Square Nut, Washer, Hexagonal Bolt with Hexagonal Nut and Washer		
SHEET NUMBER 2:		**6 Hours**
Socket and Spigot Cotter Joint		
SHEET NUMBER 3:		**3 Hours**

Knuckle Joint		
SHEET NUMBER 4:		**3 Hours**
Welded Joint (Types and Symbol of Welded Joints)		
SHEET NUMBER 5:		**6 Hours**
Riveted Joint (Single Riveted Lap Joint), Double Riveted Lap (Chain and Zigzag) Joint, Single Riveted (Single and Double Strap) Butt Joint.		
TOTAL LECTURES		**24 Hours**

Books:

1. Bhandari V. B., Design of Machine Elements, Prentice Hall of India, 2017
2. A Text Book of Machine Drawing by P.S. Gill, S.K. Katariya and Sons, 2013

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	2	-	-	-	-	-	-	-	-	1	3	2	-
CO2	3	3	3	2	-	-	-	-	-	-	-	2	3	3	-
CO3	3	3	3	2	-	-	-	-	-	-	-	2	3	3	-
CO4	2	2	2	-	-	-	-	-	-	-	-	1	3	2	-
CO5	3	3	2	2	-	-	-	-	-	-	-	2	3	3	-
CO6	2	2	3	2	3	-	-	-	-	-	-	2	3	3	-

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Fluid Machines Lab	**Subject Code:** TIU-UME-L216
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE :

Enable the student to:

correlate the classical experiments of turbines and pumps related to fluid machines theory

COURSE OUTCOME :

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

CO1	Apprehend the working of reaction turbine and its basic components	K2
CO2	Apprehend the working of reaction turbine and its basic components	K2
CO3	Comprehend the working of different type of pumps	K2
CO4	Able to calculate the efficiency of the Centrifugal pump and Submersible pump and draw the performance curves	K3
CO5	Able to draw the performance characteristics and efficiencies of Kaplan turbine and Francis turbine	K4
CO6	Understand the constructional details of a Pelton turbine in detail	K2

COURSE CONTENT :

MODULE 1:	**FRANCIS TURBINE**	**3 Hours**
To draw the characteristic curves of a Francis turbine		
MODULE 2:	**KAPLAN TURBINE**	**3 Hours**
To draw the characteristic curves of a Kaplan turbine		
MODULE 3:	**CENTRIFUGAL PUMP**	**3 Hours**
To draw the characteristic curves of a Centrifugal pump		
MODULE 4:	**SUBMERSIBLE PUMP**	**3 Hours**
To draw the characteristic curves of a Submersible pump		
MODULE 5:	**PELTON TURBINE**	**3 Hours**
Study experiment on the model of the Pelton turbine		
MODULE 6:	**RECIPROCATING PUMP**	**3 Hours**
Study experiment on the model of the Reciprocating pump		
TOTAL LECTURES		**18 Hours**

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	-	-	1	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	1	-	-	-	-	-	-	1	2	-	-
CO3	2	2	-	-	2	-	-	-	-	-	-	1	3	-	-
CO4	2	-	2	2	3	-	-	-	-	-	-	2	3	-	2
CO5	2	-	2	-	3	-	-	-	-	-	-	2	3	-	2
CO6	3	1	-	-	2	-	-	-	-	-	-	1	2	-	-

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 2nd Yr., 4th Sem.
Course Title: Problem Solving with Advance Excel and Power BI	**Subject Code:** TIU-CASD-UME-S298A
Contact Hours/Week: 0–0–2 (L–T–P)	**Credit:** 1

COURSE OBJECTIVE :

Enable the student to:

- Apply advanced Excel functions for efficient data analysis and problem-solving.
- Clean and transform data using Excel tools for accurate analysis.
- Create interactive visualizations and reports using Microsoft Power Business Intelligence.
- Perform custom calculations and advanced data analysis using expressions in Microsoft Power Business Intelligence.

COURSE OUTCOME :

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

CO1	Explain the use of advanced Excel formulas such as INDEX, MATCH, OFFSET, and array functions.	K2
CO2	Apply pivot tables, slicers, and charts to perform detailed data analysis in Microsoft Excel.	K3
CO3	Analyze and clean datasets in Microsoft Excel using techniques such as removing duplicates and text-to-columns.	K4
CO4	Develop basic interactive dashboards in Microsoft Power Business Intelligence using transformed data.	K3
CO5	Evaluate integration of Excel with Power Business Intelligence for effective report generation.	K5
CO6	Create advanced analytical measures using data analysis expressions in Microsoft Power Business Intelligence.	K6

COURSE CONTENT :

MODULE 1:	**Advanced Excel Formulas and Functions**	**5 Hours**
Understand and apply advanced Excel formulas such as INDEX, MATCH, OFFSET, and array		

functions.		
MODULE 2:	**Pivot Tables and Data Analysis**	**4 Hours**
Perform advanced data analysis using pivot tables, slicers, and pivot charts.		
MODULE 3:	**Data Cleaning and Transformation with Excel**	**3 Hours**
Learn data cleaning techniques such as removing duplicates, handling missing values, and text-to-columns.		
MODULE 4:	**Introduction to Power BI**	**3 Hours**
Learn the basics of Power BI, including data import, data transformation, and creating visualizations.		
MODULE 5:	**Integrating Excel with Power BI**	**4 Hours**
Learn to integrate Excel with Power BI by importing Excel data, creating reports, and publishing dashboards.		
MODULE 6:	**Advanced Data Analysis with DAX in Power BI**	**5 Hours**
Understand and apply DAX for creating custom measures and calculations in Power BI.		
TOTAL LECTURES		**24 Hours**

Books:

1. Excel 2019 Power Programming with VBA by Michael Alexander, Dick Kusleika, Wiley.
2. Microsoft Excel 2019 Bible by Michael Alexander, John Walkenbach, Wiley.
3. The Definitive Guide to DAX by Marco Russo, Alberto Ferrari, Microsoft Press.
4.Mastering Microsoft Power BI by Brett Powell, Packt Publishing.

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	2	2	-	-	3	-	-	-	-	-	-	1	2	-	-
CO2	2	3	-	-	3	-	-	-	-	-	-	1	3	-	-
CO3	2	2	-	-	3	-	-	-	-	-	-	2	3	-	-
CO4	2	-	3	-	3	-	-	-	-	-	-	2	3	-	2
CO5	2	-	3	-	3	-	-	-	-	-	-	2	3	-	2
CO6	2	2	-	2	3	-	-	-	-	-	-	2	3	-	3

SEMESTER 5

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr. 5thSem.
Course Title: Heat Transfer	**Subject Code:** TIU-UME-T301
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

- identify the important modes of heat transfer and their applications
- familiarize with the conduction, radiation and convective heat transfer concepts
- learn the effectiveness and rating of heat exchangers

COURSE OUTCOME :

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

CO1	Describe different modes of heat transfer	K2
CO2	Derive the basic laws of conduction heat transfer	K2
CO3	Apply and analyze one-dimensional heat conduction equation including transient problems	K4
CO4	Analyze and solve problems in thermal radiation and radiation exchange between surfaces	K4
CO5	Illustrate basic knowledge of convective heat transfer	K4
CO6	Solve simple heat exchanger problems	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**2 Hours**
Introduction to Heat Transfer, Rate equations in conduction, convection and radiation, relationship to Thermodynamics.		
MODULE 2:	**BASIC CONCEPTS OF CONDUCTION**	**4 Hours**
The conduction rate equation, thermal properties of matter; Heat diffusion equation in Cartesian, cylindrical and spherical coordinates, boundary and initial conditions.		
MODULE 3:	**ONE-DIMENSIONAL STEADY-STATE CONDUCTION EQUATION**	**13 Hours**

One-dimensional steady-state conduction for plane wall, cylindrical wall, spherical wall and composite wall; Temperature distribution, thermal resistance, conduction with thermal energy generation; Heat transfer from extended surfaces (fins); Transient Conduction: the lumped capacitance method and its validity, general lumped capacitance method of analysis		
MODULE 4:	**INTRODUCTION TO RADIATION**	**7 Hours**
Fundamental properties, blackbody radiation, the Planck distribution, Wien's displacement law, the Stefan-Boltzmann law, Kirchhoff's law; Radiation exchange between black surfaces, view factor relations, radiation exchange between opaque, diffuse and gray surfaces in an enclosure, two-surface and three-surface enclosures, radiation shield.		
MODULE 5:	**INTRODUCTION TO CONVECTION**	**15 Hours**
Concept of thermal boundary layer, derivation of thermal boundary layer equations, dimensionless parameters and their significance, Reynolds analogy, derivation of the energy equation; External and internal forced convection: flat plate in parallel flow, cylinder in cross flow; Concept of thermally fully developed flow; Laminar flow in circular tubes: hydrodynamic considerations, thermal analysis and correlations; Natural convection: Physical considerations, governing equations, the vertical plate in natural convection.		
MODULE 6:	**HEAT EXCHANGERS**	**4 Hours**
Classification of heat exchangers, overall heat transfer coefficient; Heat exchanger (parallel-flow and counter-flow) analysis using LMTD and NTU method; Heat exchanger design and performance calculations.		
TOTAL LECTURES		**45 Hours**

Books:

1. F. P. Incropera, D. P. Dewitt, T. L. Bergman and A. S. Lavine, "Fundamentals of Heat and Mass Transfer", John Wiley & Sons Inc, Eighth Edition, 2020, ISBN: 978-1119722489.
2. Y. A. Cengel and A. J. Ghajar, "Heat and Mass Transfer: Fundamentals and Applications (SIE)", McGraw Hill Education, Fifth Edition, 2017, ISBN: 978-9339223199.
3. M. Thirumaleshwar, "Fundamentals of Heat and Mass Transfer", Pearson Education India, First Edition, 2006, ISBN: 978-8177585193.

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	-	-	-	-	-	-	-	-	-	-	-	3	-	-
CO2	3	2	2	-	-	-	-	-	-	-	-	-	3	-	-
CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	-
CO5	3	2	2	-	-	-	-	-	-	-	-	-	2	3	-
CO6	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 5th Sem.
Course Title: Design of Machine Elements I	**Subject Code:** TIU-UME-T311
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. introduce the fundamental principles of machine design, including strength of materials, failure theories, and material selection for mechanical components.
2. develop the ability to analyze and design basic machine elements and joint assemblies.
3. have awareness of important national and international codes related to machine design.

COURSE OUTCOME :

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

CO1	Understand the fundamentals of machine design and standardization principles.	K2
CO2	Analyze different static failure theories and methods to reduce stress concentration.	K2
CO3	Apply fatigue failure theories for fluctuating load conditions.	K3
CO4	Design shafts, keys, and couplings based on strength and functionality	K3
CO5	Evaluate riveted joints considering efficiency and different failure modes.	K3
CO6	Design welded and bolted joints for different loading conditions.	K3

COURSE CONTENT :

MODULE 1:	**Introduction to Machine Design**	**6 Hours**

Design philosophy, Types of design, Basic procedure of machine design, preferred sizes, Fits and Tolerance, Surface roughness, Introduction to National and International Design Codes and standards.		
MODULE 2:	**Failure Theories**	**7 Hours**
Theories of static failure (Principal Stress Theory, Tresca Failure criterion, Distortion Energy Failure Theory etc.). Selection and application of failure theories. Notch sensitivity, Stress concentration, stress concentration factor and methods to reduce stress concentration		
MODULE 3:	**Design Against Fluctuating Loads**	**9 Hours**
Different types of variable loads (e.g, reversed load, repeated load, static offset etc.), Fatigue in metals, Wohler's (S-N) curve, Endurance life, Infinite life and Finite Life Design. Effect of mean stress in design life. Fatigue failure theories (e.g., Soderberg, Goodman, Modified Goodman and Gerber). Infinite life and Finite Life Design. Design Life for variable load cycles, Cumulative damage, Miner's Rule, Failure under torsional and axial loading.		
MODULE 4:	**Design of Shafts, and Shaft Components**	**10 Hours**
Shafts: Types of shafts, Design of shaft by strength, Design of shaft by angle of twist, Design of shaft by ASME code. Keys: Keys and various types of keys. Design of square and flat keys Design of Couplings: Functions and applications of couplings, Muff coupling and design of muff coupling, Clamp coupling and design of clamp coupling, Rigid flange coupling and design of flange coupling.		
MODULE 5:	**Design of Riveted Joints**	**6 Hours**
Rivets and types of rivet head, Types of riveted joints, Rivet terminology, Design of riveted joint: Tearing, Shearing and Crushing failure, Efficiency of riveted joint, eccentrically loaded rivets.		
MODULE 6:	**Design of Welded and Bolted Joints**	**10 Hours**
Types of welded joints (Butt Joint, Lap Joint, Fillet Joint), Weld terminology and symbols, Design of welded joints: transverse and parallel fillet weld. Eccentrically loaded welded joint. Bolted Joints: Bolt terminologies, Bolted joint analysis: joints subjected to direct tensile force, subjected to shear, Effect of pre-tensioning and integrity of bolted joints. Eccentrically loaded bolted joints. Gaskets and their application in flanged joints.		
TOTAL LECTURES		**48 Hours**

Books:

Main Reading

4. Bhandari V. B., Design of Machine Elements, Prentice Hall of India, 2017
5. Budynas R. G., Nisbett J. K., Shigley's Mechanical Engineering Design, 2017.

Supplementary Reading

1. Khurmi R. S. Gupta J. K., A Textbook of Machine Design, S. Chand Publisher, 2020.
2. Spotts M. F. Shoup T. F., Hornberger L. E., Design of Machine Elements, Pearson, 2019

Online Link:

https://archive.nptel.ac.in/courses/112/105/112105125/

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	2	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	3	-

CO3	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	2	-	-	-	-	-	-	-	-	3	2	3
CO6	3	3	3	2	-	-	-	-	-	-	-	-	3	3	3

TECHNO INDIA UNIVERSITY

W E S T B E N G A L

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 5th Sem.
Course Title: Dynamics of Machinery	**Subject Code:** TIU-UME-T313
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

- get a basic knowledge of dynamic force analysis and inertia forces in machinery
- be acquainted with different methods of balancing techniques employed in engines
- undesrstand the concepts of discrete and continuous vibrating systems

COURSE OUTCOME :

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

CO1	Understand the concepts of dynamic force analysis and inertia forces in reciprocating machinery and turning-moment diagrams in engines	K2
CO2	Understand the concept of balancing of different engines	K2
CO3	Understand the basic knowledge of the concepts of gyroscope and its applications in engineering.	K4
CO4	Understand the concepts of different types of vibrations	K3
CO5	Understand the concepts of force and displacement transmissibility, vibration isolation and the use of vibration measuring instruments like seismometer and accelerometer	K3
CO6	Understand the concepts of continuous systems and their vibration properties	K3

COURSE CONTENT :

MODULE 1:	**DYNAMIC FORCE ANALYSIS**	**9 Hours**
Dynamic Force Analysis: D'Alembert's principle, dynamic analysis of single-slider machines, velocity and acceleration of a piston, angular velocity and angular acceleration of the connecting rod, engine force analysis, turning moment on crankshaft, dynamically equivalent system, turning-moment diagrams, fluctuation of energy, flywheels, dimensions of flywheel rim, punching press		

and shearing machines		
MODULE 2:	**BALANCING OF RECIPROCATING AND ROTATING MACHINERY**	**11 Hours**
Balancing: static balancing, dynamic balancing, transference of a force from one plane to another, balancing of several masses in different planes, balancing of reciprocating masses, primary and secondary balancing, balancing of inline engines, balancing of V-engines, balancing of W, V-8, V-12 engines, balancing of radial engines, method of primary and secondary direct and reverse cranks and analytical method, balancing machines		
MODULE 3:	**GYROSCOPE**	**7 Hours**
Gyroscope: Concepts of angular velocity and acceleration, gyroscopic torque, gyroscopic effect on aircraft, gyroscopic effect on naval ships, stability of an automobile, stability of two-wheeled vehicles		
MODULE 4:	**VIBRATIONS**	**18 Hours**
Vibrations: definitions, types of vibrations, basic features of vibrating systems, degrees of freedom, longitudinal vibrations, displacement, velocity and acceleration, inertia effects of the mass of spring in a simple spring-mass system, damped vibrations, logarithmic decrement, forced vibrations, forced-damped vibrations, magnification factor, vibration isolation and transmissibility, vibration measuring instruments: seismometer and accelerometer, rotating unbalance, support motion, transverse vibrations of continuous systems, Dunkerley's method and Rayleigh's method, whirling of shafts, torsional vibrations of a single rotor, inertia effect of the mass of shaft on torsional vibrations, free torsional vibrations of a two-rotor and three-rotor system, torsionally equivalent shaft		
TOTAL LECTURES		**45 Hours**

Books:

6. Theory of Machines by S.S. Rattan, Tata McGraw Hill Education Pvt Ltd.
7. Engineering Mechanics (Dynamics) by J.L. Meriam and L.G. Kraige, John Wiley & Sons Inc.
8. Fundamentals of Vibrations by Leonard Meirovitch, Waveland 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	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	2	2	-	-	-	-	-	-	-	-	3	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	2	2	-
CO4	3	3	3	2	-	-	-	-	-	-	-	-	3	3	2
CO5	3	3	3	3	2	-	-	-	-	-	-	-	3	3	3
CO6	3	3	2	2	-	-	-	-	-	-	-	-	3	3	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 5th Sem.
Course Title: Conventional and Non-conventional Machining Technology	**Subject Code:** TIU-UME-T315
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4
Prerequisite Course: Material Science (TIU-UME-T217); Manufacturing Processes (TIU-UME-T218)	

Course Objective:

Enable the student to:

- understand fundamentals of conventional and unconventional machining
- explore non-traditional machining techniques
- apply machining knowledge for process selection and optimization

Course Outcome:

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

CO1	Understanding of machine tools and its applications	K1
CO2	Recognize and decide different machine tools for product development	K2
CO3	Analyze machining parameters and estimate the machining time.	K3
CO4	Correlate the general concept of metal cutting to various machining operations	K3
CO5	Apply the working principles and processing characteristics of non-traditional machining to the production of precision components	K4
CO6	Employ advanced micro-manufacturing processes for product development	K4

Course Content:

Module-1:	Basic machine tools: Machining principles, basic idea of machine tool in detail	**4 hours**
Module-2:	Lathe, milling, drilling, shaping, planning, slotting, and broaching: constructional features and mechanisms, types, specifications and applications/ operations	**10 hours**
Module-3:	Finishing processes: honing, lapping and super-finishing processes; Machining time: estimation of machining time.	**5 hours**
Module-4:	Basic of Unconventional machining: Introduction to the principles and applications of unconventional machining processes, Classification of non-traditional Machining Processes, Need for non-traditional Machining	**4 hours**
Module-5:	Non-traditional Machining Processes: Electro Discharge machining (EDM), Electro Chemical machining (ECM), Abrasive Jet machining (AJM), Water Jet machining (WJM), Ultrasonic Machining (USM), Electron Beam machining (EBM), Laser Beam Machining (LBM): Parameters, responses, mechanism and analysis, effect on material, applications, economics and selection of process; Hybrid processes	**22 hours**
TOTAL LECTURES		**45 hours**

Recommended Books:

Main Reading

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

Supplementary Reading

1. A. Ghosh and A.K. Mallik, Manufacturing Science, Ellis Horwood.
2. H.N. Gupta, R.C. Gupta and A. Mittal, Manufacturing Processes, New Age International (P) Limited.
3. G. Boothroyd and W.A. Knight, Fundamentals of Machining and Machine Tools, CRC Press Taylor & Francis Group.

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	2	-	-	-	-	-	-	-	-	-	3	2	-

CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	2	2	-	-	-	-	-	-	-	3	3	2
CO5	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3
CO6	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 5th Sem.
Course Title: Refrigeration and Airconditioning Systems	**Subject Code:** TIU-UME-T317
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand the fundamental principles of refrigeration and air-conditioning, including refrigeration cycles and performance evaluation.
2. Analyze the working and efficiency of vapor compression, air refrigeration, and vapor absorption systems using thermodynamic diagrams.
3. Evaluate refrigerants based on nomenclature, properties, and environmental impact, ensuring compliance with global standards.
4. Design and implement refrigeration and air-conditioning systems by selecting appropriate equipment, control mechanisms, and psychrometric processes for optimal performance.

COURSE OUTCOME :

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

CO1	Define the fundamental concepts of refrigeration and air-conditioning from second law of Thermodynamics, including refrigeration units and principles.	K1
CO2	Explain the working principles and performance analysis of vapor compression and air refrigeration systems (VCRS & ARS) using p-h and T-s diagrams, including COP determination and limitations.	K2
CO3	Analyze vapor absorption refrigeration systems (VARS) based on their working principles, advantages, and limitations	K4
CO4	Classify refrigerants based on nomenclature, properties, environmental impact, and compliance with ODP and GWP regulations.	K2
CO5	Analyze major refrigeration equipment, including compressors, condensers,	K4

	evaporators, and expansion devices, and their role in optimizing system performance	
CO6	Apply psychrometric charts to psychrometric processes and air-conditioning for heat load estimation.	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**2 Hours**
Concepts of Refrigeration and Air-conditioning, Unit of refrigeration		
MODULE 2:	**SIMPLE VAPOUR COMPRESSION REFRIGERATION SYSTEM**	**6 Hours**
Vapour compression cycle on p-h and T-s diagrams, Cycles with sub-cooling and superheating, their effects. Effect of changes in evaporator pressure and condenser pressure on the performance of a simple VCRS, dry compression and wet compression of refrigerant, actual Vapour Compression cycle.		
MODULE 3:	**AIR REFRIGERATION SYSTEM (ARS)**	**3 Hours**
open-air and dense-air system, limitations of Bell-Coleman refrigerator, COP determination, actual air-refrigeration cycle.		
MODULE 4:	**VAPOUR ABSORPTION REFRIGERATION SYSTEM (VARS)**	**6 Hours**
Advantages of VARS over VCRS, working principle of simple VARS, practical VARS, limitations of VARS, maximum COP of a VARS, Li- Br-water system and Aqua-ammonia systems.		
MODULE 5:	**REFRIGERANTS**	**3 Hours**
Refrigerants: Nomenclature, Classification, Desirable properties, Environmental regulations, ODP, GWP.		
MODULE 6:	**EQUIPMENT AND CONTROL**	**7 Hours**
Major Refrigeration Equipment – Compressors: Types, reciprocating, rotary & centrifugal, volumetric efficiency; Condensers: types used in refrigeration systems; Evaporators; Expansion devices: capillary tubes and thermostatic expansion valves.		
MODULE 7:	**PSYCHROMETRY**	**6 Hours**
Basic definitions and principles related to Psychrometry, Psychrometric charts & their uses. Heating, cooling, heating & humidification & cooling & dehumidification processes. Adiabatic saturation, By-pass factor, Sensible Heat Factors. Simple cases of Heat Load estimation.		
MODULE 8:	**TYPES OF AIR-CONDITIONING SYSTEMS AND AIR-CONDITIONING EQUIPMENT**	**6 Hours**
Window air conditioners & split air conditioners. Single duct, double duct & V A V systems. Chillers, air handling units, cooling towers, cooling coils.		
TOTAL LECTURES		**39 Hours**

Books:

1. Refrigeration and Air Conditioning by C.P. Arora, McGraw Hill Education (India) Private Limited.
2. Refrigeration and Air Conditioning by R.C. Arora, PHI Learning Pvt. Ltd.
3. A Textbook of Refrigeration and Air Conditioning by R.S. Khurmi and J.K. Gupta, S Chand.
4. Hand book of heating, ventilation and Air-conditioning, Jan. F. Kreider, CRC press.
5. Automotive heating and Air-conditioning, Mike Stubblefield and John H Haynes
6. Heating ventilation and air conditioning – Jan F. Kreider

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	-	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	3	-
CO3	3	3	2	2	-	-	-	-	-	-	-	-	3	3	-
CO4	2	2	-	-	-	3	3	-	-	-	-	-	2	3	-
CO5	3	3	2	2	3	-	-	-	-	-	-	-	3	3	2
CO6	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 5th Sem.
Course Title: Heat Transfer Lab	**Subject Code:** TIU-UME-L307
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE :

Enable the student to:

correlate the experiments related to heat transfer theory

COURSE OUTCOME :

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

CO1	Analyze the heat transfer from a composite slab	K4
CO2	Understand how to determine the effectiveness and efficiency of a pin fin	K2
CO3	Illustrate to determine the heat transfer coefficient in forced convection	K3
CO4	Gain knowledge as to how to determine the heat transfer coefficient in natural convection	K2
CO5	Determine different heat exchanger performance parameters	K3
CO6	Understand how to determine the Stefan Boltzmann's constant in thermal radiation	K2

COURSE CONTENT:

MODULE 1:	**DETERMINATION OF THERMAL CONDUCTIVITY**	**3 Hours**
Study of conduction heat transfer and determination of thermal conductivity.		
MODULE 2:	**DETERMINATION OF FIN PERFORMANCE**	**3 Hours**

Study of heat transfer through a fin and determination of fin performance parameters		
MODULE 3:	**FORCED CONVECTION ANALYSIS**	**3 Hours**
Study of forced convective heat transfer and determination and validation of heat transfer coefficient and Nusselt number		
MODULE 4:	**FREE CONVECTION ANALYSIS**	**3 Hours**
Study of free convective heat transfer and determination and validation of heat transfer coefficient and Nusselt number		
MODULE 5:	**HEAT EXCHANGER ANALYSIS**	**3 Hours**
Study of various types of heat exchangers, like shell and tube heat exchangers, plat heat exchanger, tubular heat exchangers etc. Determination of heat exchanger performance parameters.		
MODULE 6:	**STUDY OF RADIATIVE HEAT TRANSFER**	**3 Hours**
Determination of emissivity of gray surface, determination of Stefan-Boltzmann constant.		
TOTAL LECTURES		**18 Hours**

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	3	2	2	2	-	-	-	-	-	-	-	3	3	2
CO2	3	3	2	2	2	-	-	-	-	-	-	-	3	3	2
CO3	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3
CO4	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3
CO6	3	3	2	2	3	-	-	-	-	-	-	-	3	3	3

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 5th Sem.
Course Title: Fluid Machinery Lab	**Subject Code:** TIU-UME-L309
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE:

Enable the student to:
correlate the classical experiments of turbines and pumps related to fluid machines theory

COURSE OUTCOME:

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

CO1	Apprehend the working of reaction turbine and its basic components	K4
CO2	Apprehend the working of reaction turbine and its basic components	K2
CO3	Comprehend the working of different type of pumps	K3
CO4	Able to calculate the efficiency of the Centrifugal pump and Submersible pump and draw the performance curves	K2
CO5	Able to draw the performance characteristics and efficiencies of Kaplan turbine and Francis turbine	K3
CO6	Understand the constructional details of a Pelton turbine in detail	K2

COURSE CONTENT:

MODULE 1:	**FRANCIS TURBINE**	**3 Hours**
To draw the characteristic curves of a Francis turbine		
MODULE 2:	**KAPLAN TURBINE**	**3 Hours**

To draw the characteristic curves of a Kaplan turbine		
MODULE 3:	**CENTRIFUGAL PUMP**	**3 Hours**
To draw the characteristic curves of a Centrifugal pump		
MODULE 4:	**SUBMERSIBLE PUMP**	**3 Hours**
To draw the characteristic curves of a Submersible pump		
MODULE 5:	**PELTON TURBINE**	**3 Hours**
Study experiment on the model of the Pelton turbine		
MODULE 6:	**RECIPROCATING PUMP**	**3 Hours**
Study experiment on the model of the Reciprocating pump		
TOTAL LECTURES		**18 Hours**

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	2	2	2	-	-	-	-	-	-	-	3	3	2
CO2	3	2	2	2	2	-	-	-	-	-	-	-	3	3	2
CO3	3	2	2	2	2	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO5	3	3	3	3	3	-	-	-	-	-	-	-	3	3	3
CO6	3	2	2	2	2	-	-	-	-	-	-	-	3	3	2

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B.Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 5th Sem.
Course Title: AutoCAD Lab	**Subject Code:** TIU-UME-L311
Contact Hours/Week:0–0–3(L–T–P)	**Credit**: 1.5

COURSE OBJECTIVE:

Enable the student to:
Impart the knowledge of CAD commands for drawing 2D and 3D Machine parts drawings required for various Mechanical engineering applications.

COURSE OUTCOME :

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

CO1	Understand the basic of Auto-Cad in correlation with Engineering Drawing and Machine Drawing	K2
CO2	Become familiar with various Auto-Cad Drawing Tools	K1
CO3	Understand the application of various modified Drawing tools of Auto CAD	K2
CO4	Apply Auto CAD computational analysis tools to engineering design and create a complete CAD documentation for an engineering design.	K3
CO5	Develop simple 3D objects and obtain different views	K6
CO6	Able to apply various Drawing Tools of Auto-Cad for solving complex design	K3

COURSE CONTENT:

MODULE 1:	**GETTING STARTED WITH AUTOCAD**	**3 Hours**
Opening and Creating Drawings, Exploring the AutoCAD interface, Zooming and Panning		
MODULE 2:	**BASIC DRAWING & EDITING COMMANDS**	**3 Hours**
Using the Mouse, Keyboard, and Enter Key to work quickly and efficiently in AutoCAD, Lines,		

Circles, Rectangles		
MODULE 3:	**PROJECTS-CREATING A SIMPLE DRAWING**	**3 Hours**
Creating Simple Drawings, Using Object Snap Tracking to extrapolate a projected top view, Using Modify tools to arrange an office layout		
MODULE 4:	**Drawing Precision in AutoCAD**	**3 Hours**
Polar and Ortho Tracking, Entering Coordinates and Angles, Object Snaps and Tracking		
MODULE 5:	**MAKING CHANGES IN YOUR DRAWING**	**3 Hours**
Move, Copy, Rotate, Mirror		
MODULE 6:	**ORGANIZING YOUR DRAWING WITH LAYERS**	**3 Hours**
Layer States, Properties by Layer, Layer Tools, Polylines, Arcs, Polygons, Ellipses		
MODULE 7:	**ANALYZING MODEL AND OBJECT PROPERTIES**	**3 Hours**
The Properties Palette, Quick Select, Select Similar, Measure Geometry Tools		
MODULE 8:	**ADVANCED EDITING COMMANDS**	**3 Hours**
Trim and Extend, Fillet and Chamfer, Polyline Edit and Spline, Offset and Explode, Join		
MODULE 9:	**3D DRAWINGS**	**3 Hours**
3D Modeling Concepts in AutoCAD		
MODULE 10:	**TEXT**	**3 Hours**
The Multiline Text Tool, The Single Line Text Tool, Editing Text, Text in Model Space vs. Paper Space, The Multileader Tool		
TOTAL LECTURES		**30 Hours**

Books:

1. N.D. Bhatt, " Engineering Drawing", Charotar, 2014, ISBN- 978-93-80358-96-3.
2. T. Jeyapoovan, "Engineering Drawing and Graphics Using Autocad" Vikas Publishing, 2010, 9788125940005.
3. https://www.autodesk.com/in/products/autocad/overview?term=1 YEAR&tab=subscription.

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	-	2	-	-	-	-	-	-	-	3	2	2
CO2	3	-	2	-	3	-	-	-	-	-	-	-	3	2	3
CO3	3	-	2	-	3	-	-	-	-	-	-	-	3	2	3
CO4	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3
CO5	3	-	3	-	3	-	-	-	-	-	-	-	3	3	3
CO6	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 3rd Yr., 5th Sem.
Course Title: Career Advancement & Skill Development	**Subject Code:** TIU-UTR-S301
Contact hours/week: 3-0-0 (L-T-P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. **Acquire comprehensive knowledge of SAP ERP systems**, with a particular emphasis on the Sales and Distribution (SD) and Material Management (MM) modules.
2. **Develop a thorough understanding of core business processes** within the SD and MM modules, including order-to-cash, procurement, and inventory management workflows.
3. **Gain practical experience in integrating SAP modules**, applying real-world scenarios to optimize business processes and operational efficiency.
4. **Prepare for SAP certification** and enhance career prospects by acquiring the expertise necessary for roles in ERP implementation, business process optimization, and management.

COURSE OUTCOME :

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

CO1	Gain expertise in SAP S/4HANA architecture, core business processes, optimization, and preparation for certification.	K5
CO2	Develop proficiency in navigating SAP systems, understanding their interface, and efficiently accessing key functionalities.	K 3
CO3	Gain a foundational understanding of SAP S/4HANA through hands-on experience with the GBI model for business processes.	K 2
CO4	Understand and apply the Sales & Distribution business processes in SAP, including order management, pricing, shipping, and billing.	K 3
CO5	Gain expertise in the integrated Materials Management process in SAP, covering	K 4

	procurement, inventory management, and materials planning.	

COURSE CONTENT :

MODULE 1:	**Building Tomorrow's ERP with SAP S/4HANA**	**6 Hours**
□ The Future of ERP □ Discover the Value of SAP S/4HANA □ SAP S/4HANA: Scope and Intelligent Processes □ A Modern User Experience with SAP S/4HANA □ Central Business Configuration for SAP S/4HANA Cloud		
MODULE 2:	**Navigation in SAP Systems**	**6 Hours**
□ Log on to the system. □ Initial Screen: Menu Bar, Title Bar, Application Toolbar, SAP Easy Access Menu □ Favourites: Add T-Code, Folder, URL □ Transaction Codes □ User Specific Settings □ Help Functions		
MODULE 3:	**Introduction to S/4HANA using GBI**	**9 Hours**
□ GBI Business Story □ SAP S/4HANA Architecture □ Organizational Structure □ Products □ Business Process		
MODULE 4:	**Sales & Distribution Business Process**	**9 Hours**
□ Over view of SD □ Creating Master Data □ Sales order process □ Pre-sales Activities □ Shipping, Billing, Credit Management		
MODULE 5:	**Integrated Materials Management Process**	**8 Hours**
□ Over view of Material Management □ MM organization structure □ Creating Master Data □ Purchasing Information R □ Creating Invoice, Goods Receipt, Payment		
TOTAL		**38 Hours**

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	-	3	2	3	-	-	-	-	-	-	2	3	3	2
CO2	2	-	2	-	3	-	-	-	-	-	-	-	3	3	3
CO3	3	2	3	-	3	-	-	-	-	-	-	2	3	3	3
CO4	2	-	3	2	3	-	-	-	-	-	-	2	3	3	3
CO5	2	-	3	2	3	-	-	-	-	-	-	2	3	3	3

SEMESTER 6

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Thermal Systems	**Subject Code:** TIU-UME-T328
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE:

Enable the student to:

- Describe the principles of gas and vapor power cycles and their applications.
- Differentiate thermodynamic cycles based on efficiency and performance.
- Assess fuel properties and combustion systems for engine performance.
- Illustrate lubrication, cooling, and combustion chamber design effects.
- Optimize boiler and turbine systems for efficient power generation.

COURSE OUTCOME:

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

CO 1	Define fundamental thermodynamic concepts, including gas and vapor power cycles, internal combustion engines, and fuel supply systems	K1
CO 2	Describe the working principles of gas power cycles, internal combustion engines, and their combustion characteristics	K2
CO 3	Apply thermodynamic laws to analyze gas and vapor power cycles for efficiency improvement.	K3
CO 4	Illustrate the impact of combustion, lubrication, and cooling systems on engine performance.	K3
CO 5	Classify various fuels and fuel supply mechanisms based on their properties and effects on engine performance	K2
CO 6	Analyze the performance of boilers and turbines based on efficiency and energy losses.	K4

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**2 Hours**
Basics of Second Law of Thermodynamics, Properties of Pure Substance, Recapitulation of Heat Engines IC Engines and Gas Power Cycles, and Vapour Power Cycle.		
MODULE 2:	**GAS POWER CYCLE**	**6 Hours**
Stirling cycle, Brayton cycles. Gas turbine cycles with intercooling, reheating and regeneration. Use of air tables for gas power cycle analysis. Application of the Gas Power Cycle		
MODULE 3:	**INTERNAL COMBUSTION ENGINES**	**4 Hours**
Principle of working, Basic Engine Types, Components of IC Engine, Analysis of air standard cycles (Otto, Diesel, Dual), fuel-air cycles and actual cycle. Availability aspects of cycles.		
MODULE 4:	**FUEL AND FUEL SUPPLY SYSTEMS**	**8 Hours**
Classification of IC engine fuels, Desirable characteristics of SI & CI engine fuels, Rating of SI & CI engine fuels, Alternative fuels for SI and CI engine (liquid, gaseous, hydrogen, LPG, CNG, Biogas etc.), Carburetion: Air-fuel ratio requirement, Working principle, Analysis of a simple carburettor, Defects of a simple carburettor and its remedy. Classification of diesel fuel injection systems, Working principle, Engine requirements, Injection pumps and nozzles.		
MODULE 5:	**COMBUSTION AND LUBRICATION SYSTEM**	**8 Hours**
Theories of normal and abnormal combustion in SI & CI engine, parameters influencing combustion, prevention of abnormal combustion in SI & CI engine. Types of combustion chamber & principle of combustion chamber design in SI & CI engine Principles of lubrication, properties of lubricating oil, lubrication systems. Principles of cooling, air & water cooling systems		
MODULE 6:	**VAPOUR POWER CYCLES**	**6 Hours**
Carnot cycle, Rankine cycle, Reheat cycle, Regenerative cycles, Effect of operating variables on Regenerative cycles, Availability analysis of cycles, Binary vapour cycle, Co-generative cycles, Combined Gas Vapour cycles		
MODULE 7:	**COMPONENTS OF VAPOUR POWER CYCLE**	**10 Hours**
Classification of Boilers, Fire and water-tube boilers. Mountings and Accessories of boilers Auxiliary heating surfaces: super heater, reheater, economizer, air preheater. Losses in boilers. Equivalent evaporation. Boiler efficiency. Basics of water treatment and ash handling. Classifications of turbines, Nozzles: types, flow through nozzles, nozzle efficiency. Working principle of the Impulse and Reaction Turbines, Degree of reaction Principle of turbine governing, Different losses in turbine, blade erosion. Classification, Elements of condensing plant, Power plant condensers, Air leakage - effect and removal.		
TOTAL LECTURES		**44 Hours**

Books:

1. Power Plant Engineering by P.K. Nag, McGraw Hill Education (India) Private Limited.
2. Internal Combustion Engines by M.L. Mathur and R.P. Sharma, Dhanpat Rai Publications.
3. Internal Combustion Engine Fundamental by J.B. Heywood by McGraw- Hill Education.
4. Internal Combustion Engines by V. Ganesan, Tata Mcgraw Hill Education Private Limited.
5. Fundamentals of Internal Combustion Engines by H.N. Gupta, PHI Learning
6. Steam & Gas Turbines and Power Plant Engineering by R. Yadav, Central Publishing House.
7. A Textbook of Power Plant Engineering by R.K. Rajput, Laxmi Publications

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	-	-	1	-	-	-	-	-	-	1	2	-	-
CO2	2	2	-	-	2	-	-	-	-	-	-	1	2	-	-
CO3	3	3	-	2	2	-	-	-	-	-	-	2	3	-	-
CO4	2	-	2	-	2	-	-	-	-	-	-	1	2	-	2
CO5	2	-	2	-	2	-	-	-	-	-	-	1	2	-	2
CO6	3	2	-	2	3	-	-	-	-	-	-	2	3	-	3

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Design of Machine Elements II	**Subject Code:** TIU-UME-T320
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Enable the student to:

1. To analyze and design various braking and clutch systems by applying engineering principles related to force, heat generation, and torque transmission.
2. To evaluate and select appropriate rolling contact bearings and lubrication methods based on load conditions, speeds, and performance criteria.
3. To understand and apply gear design principles for spur, helical, bevel, and worm gears, ensuring strength, durability, and efficient power transmission.

COURSE OUTCOME :

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

CO1	Analyze different types of brakes, understand their working principles, and design various brake systems, including shoe, block, band, and internal expanding shoe brakes, considering braking force, heat generation, and temperature rise..	K3
CO2	Evaluate and design different types of clutches such as plate, cone, multiple-disc, and centrifugal clutches using Uniform Wear and Uniform Pressure theories to determine torque transmission capacity.	K3
CO3	Classify and analyze different rolling contact bearings, determine their static and dynamic load capacities using Stribeck's Equation, and select appropriate bearings from manufacturer catalogs based on variable loads and speeds.	K3
CO4	Understand the principles of hydrodynamic and hydrostatic lubrication, apply Petroff's Equation for friction coefficient estimation, and design hydrodynamic journal bearings using Raimondi and Boyd methods for load-carrying capacity assessment.	K3
CO5	Comprehend spur gear terminology, calculate gear forces, and design gear teeth	K3

	for strength against bending and wear using Lewis' Equation, AGMA standards, and Buckingham's Wear Equation.	
CO6	Analyze the working principles and design considerations of helical, bevel, and worm gears, determine forces in a gear train, and calculate transmitted torque and power.	K3

COURSE CONTENT :

MODULE 1:	**Braking Systems Analysis**	**8 Hours**
Different types of brakes and their applications. Theory of braking action; Knowledge of the design process for short and long shoe brakes, pivotal block brakes, internal expanding shoe brakes and band brakes; calculation of temperature rise due to heating.		
MODULE 2:	**Clutch Design and Performance**	**8 Hours**
Different types of clutches and their applications. Torque transmission capacity, Uniform Wear Theory and Uniform Pressure Theory; Design of Plate Clutch, Cone Clutch, Multiple Disc and Centrifugal clutches.		
MODULE 3:	**Rolling Contact Bearing**	**9 Hours**
Rolling Contact Bearings: Different types of rolling contact and their applications. Classification of bearings, Radial and Thrust bearings; Static and Dynamic Load Capacities of bearings; Stribeck's Equation, Equivalent Dynamic Load Capacities, Selection of bearings from catalogue, designation of bearings, Selection of bearings for variable loads and speeds.		
MODULE 4:	**Sliding Contact Bearings**	**8 Hours**
Sliding Contact Bearings: Different types of lubrication, operating principles of hydro-dynamic and hydro-static lubrication; Friction Coefficient for journal bearings -Petroff's Equation; Bearing characteristic number; Load carrying capacities of a hydro-dynamic bearing, Raimondi and Boyd Method, Sommerfeld's number; Energy loss and temperature rise in a hydro-dynamic journal bearing. Selection of bearings parameters from empirical charts		
MODULE 5:	**Gear Systems and Design of Spur Gears**	**9 Hours**
Gear Terminology; Forces on a gear tooth, Torque and Power transmitted; Forces in a gear train; Design of gear tooth against bending and wear. Lewis' Equation, Lewis Form Factor, Beam Strength, Wear Strength, Buckingham's Wear Equation, Effective load on gear tooth. Design of gear based on strength. AGMA equations for design of gears.		
MODULE 6:	**Advanced Gear Systems and Torque Transmission**	**6 Hours**
Description and general Terminology of Helical Gears, Bevel Gears and Worm and Worm Gear Forces in a gear train, calculation of transmitted torque and power.		
TOTAL LECTURES		**48 Hours**

Books:

Main Reading

1. Bhandari V. B., Design of Machine Elements, Prentice Hall of India, 2017
2. Budynas R. G., Nisbett J. K., Shigley's Mechanical Engineering Design, 2017.

Supplementary Reading

1. Khurmi R. S. Gupta J. K., A Textbook of Machine Design, S. Chand Publisher, 2020.
2. Spotts M. F. Shoup T. F., Hornberger L. E., Design of Machine Elements, Pearson, 2019

Online Link:

https://archive.nptel.ac.in/courses/112/105/112105125/

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	-	-	-	-	-	-	-	-	2	2	-
CO2	3	-	2	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO4	2	-	3	-	-	-	-	-	-	-	-	-	-	2	-
CO5	3	-	2	-	-	-	-	-	-	-	-	-	2	-	-
CO6	3	-	2	-	-	-	-	-	-	-	-	-	2	-	-

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Robotics and Automation	**Subject Code:** TIU-UME-T330
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

- get a basic knowledge of robotics and its applications in various domains
- be acquainted with different methods of spatial descriptions and transformations
- understand the concepts of forward and inverse kinematics of manipulators
- understand the different control strategies employed in robotic systems

COURSE OUTCOME :

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

CO1	Able to get a basic knowledge of Robotics and its applications in various domains.	K2
CO2	Acquainted with the different methods of spatial descriptions and transformations	K3
CO3	Understand the concepts of forward kinematics in manipulators	K4
CO4	Understand the concepts of reverse kinematics in manipulators	K4
CO5	Formulate rotational and linear velocities of rigid bodies in manipulators and Jacobians in the force domain to derive the Cartesian transformation of velocities and static forces	K3
CO6	Formulate different control strategies employed in robotic systems	K4

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**	**7 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**	**9 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.Inverse Kinematics of Manipulators: solvability, existence of solutions, multiple solutions, closed form solution techniques, geometric and algebraic solution methods.		
MODULE 4:	**INVERSE KINEMATICS OF MANIPULATORS**	**8 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**	**9 Hours**
Jacobians: Linear and rotational velocities of rigid bodies, velocity propagation from link to link, Jacobians, singularities, static forces in manipulators.		
MODULE 6:	**Robot Control Systems**	**10 Hours**
Robot Control Systems: Open-Loop and Closed-Loop Control, PID Control in Robotics, Motion Control: Position, Velocity, and Force Control, Adaptive and Learning Control for Robots, Stability and Performance of Robotic Systems.		
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.
4. Feedback Control of Dynamic Systems by G.F. Franklin, J.D. Powell and A. Emami-Naeini, Pearson Education

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	-	-	1	-	-	-	-	-	-	1	2	-	-

CO2	3	2	-	-	2	-	-	-	-	-	-	-	2	-	-
CO3	3	2	-	-	2	-	-	-	-	-	-	1	2	-	-
CO4	3	2	-	-	2	-	-	-	-	-	-	1	2	-	-
CO5	3	3	-	2	3	-	-	-	-	-	-	2	3	-	2
CO6	2	2	2	-	3	-	-	-	-	-	-	2	3	-	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Metrology and Mechanical Measurement	**Subject Code:** TIU-UME-T324
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

1. Develop proficiency in measurement techniques: Equip students with the skills to accurately use a wide range of metrology tools and instruments, such as micrometers, calipers, and coordinate measuring machines (CMM), for precise mechanical measurements.
2. Understand measurement accuracy and error analysis: Teach students the principles of measurement uncertainty, error analysis, and calibration, ensuring they can evaluate and improve the precision and reliability of measurement systems.
3. Apply metrology in industrial quality control: Enable students to apply metrological principles in real-world manufacturing and quality control settings, including the use of measurement standards and techniques to optimize product quality and performance.

COURSE OUTCOME :

CO1	To understand the basic concepts of metrology and measurement	K2
CO2	To understand linear and angular measuring instrument for measurement of various components	K2

CO3	To understand the usage of various interchangeability of components used in measurement	K4
CO4	To understand basic concept of measuring instruments	K2
CO5	To evaluate quality of surface produced using various methods	K3
CO6	To understand methods of measurement for various quantities like force, load, torque, power, temperature, displacement, velocity and acceleration	K4

COURSE CONTENT :

MODULE 1:		**6 Hours**
Definition and importance of Metrology Measurement; Methods of measurements – direct, indirect, comparison, substitution, transposition, deflection and null measurement; Errors in measurement – absolute, relative, parallax, alignment, loading, dynamic and calibration error; Units of measurements – SI base and derived units, SI prefixes of units.		
MODULE 2:		**7 Hours**
Vernier scale; construction and use of Vernier Caliper, Vernier height and depth gauge, micrometer; slip gauge. Angular Metrology: Constructional features and use of protractor, Vernier bevel protractor, angle gauges, and sine bar and slip gauges.		
MODULE 3:		**7 Hours**
(i) Level using spirit-level; (ii) Flatness using straight edge, interferometry (Newton's rings) and surface plate; Parallelism, cylindricity and concentricity using dial indicator.		
MODULE 4:		**7 Hours**
Concept of limits, tolerances and fits; Hole basis and shaft basis system of fits; Go and No Go limit gauges; plug, ring, snap, thread, radius and filler gauges.		
MODULE 5:		**5 Hours**
Working principle and application of (i) dial gauge, (ii) Cook optical comparator, (iii) back pressure Bourdon gauge pneumatic comparator, (iv) optical comparator-profile projector.		
MODULE 6:		**13 Hours**
. Functional elements of an instrument –sensing, conversion & manipulation, data transmission and presentation element; Characteristics –accuracy, precision, repeatability, sensitivity, reproducibility, linearity, threshold, calibration, response, dynamic or measurement error; Transducers – definition, primary and secondary, active and passive. Definition:Terminologies –geometrical surface, effective surface, surface roughness, roughness (primary texture), waviness (secondary texture), form, lay, sampling length; Numerical evaluation of surface roughness: peak-to-valley height (Rmax), Centre line average (CLA, Ra), average depth (Rm), smoothness value (G); Principle of operation of a Tally-surf. Displacement by LVDT; force by strain – gauge load cell and piezoelectric load cell; pressure by Bourdon – tube gauge; temperature by liquid-in-glass thermometer, thermocouples, optical pyrometer; liquid velocity by pitot tube; water flow by orifice meter.		
TOTAL LECTURES		**45 Hours**

Books:

Main Reading

1. Measurement systems – Application and Design by E.O. Doebelin and D.N. Manik, 5th ed., Tata McGraw Hill.

2. Principles of Engineering Metrology by R. Rajendra, Jaico Pub. House.
3. Metrology & Measurement by Bewoor and Kulkarni, TMH.

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	2	-	-	-	-	-	-	-	-	-	3	2	-
CO2	3	3	3	2	-	-	-	-	-	-	-	-	3	3	-
CO3	3	3	3	3	2	-	-	-	-	-	-	-	3	3	2
CO4	3	3	3	2	2	-	-	-	-	-	-	-	3	3	2
CO5	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3
CO6	3	2	3	2	3	-	-	-	-	-	-	-	3	3	3

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Metal Cutting and CNC Machines	**Subject Code:** TIU-UME-T326
Contact hours/week: 3-0-0 (L-T-P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

- Understand the fundamental concepts of machining, including tool geometry and mechanics of machining.
- Analyze chip formation, cutting forces, tool wear, and tool life to optimize machining performance.
- Explore tool reference systems and cutting fluid applications for effective machining processes.
- Gain insights into CNC technology, its advantages, limitations, and programming fundamentals.

COURSE OUTCOME :

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

CO1	**Explain** the fundamental concepts of machining, including manufacturing needs, tool geometry, and mechanics of machining.	K2
CO2	**Analyze** the mechanics of chip formation for ductile and brittle materials and identify different types of chips.	K4

CO3	**Apply** the concepts of cutting forces, tool wear, tool life, and cutting fluids to enhance machining performance.	K3
CO4	**Evaluate** the significance of Merchant's Circle Diagram in determining cutting force components.	K5
CO5	**Demonstrate** an understanding of CNC technology, including its evolution, advantages, limitations, and machine control unit.	K3
CO6	**Develop** basic CNC part programs using different programming techniques for automated machining.	K6

COURSE CONTENT :

MODULE 1:		**5 Hours**
Manufacturing needs and concept, Mechanics of machining, Concept of rake and clearance angle.		
MODULE 2:		**6 Hours**
System description of tool geometry, ASA System, Tool reference systems: ORS and NRS system.		
MODULE 3:		**7 Hours**
Mechanics of chip formation for ductile and brittle materials, Geometry and characteristics of chip formation, Build up edge formation, Type of chips..		
MODULE 4:		**9 Hours**
Cutting force components and their significances, Merchants circle diagram, Tool wear, Tool life, Types of Cutting fluids, Tool economics.		
MODULE 5:		**12 Hours**
Introduction to Computer Numerical Control (CNC), Numerical control, Functions of a machine tool, Concept of numerical control, Advantages of CNC machine tools, Evolution of CNC, Advantages of CNC, Limitations of CNC, Features of CNC, The Machine Control Unit (MCU) for CNC, Classification of CNC Machine Tools, Fundamentals of CNC programming, Part programming techniques, VNC.		
TOTAL		**39 Hours**

Recommended Books:

Main Reading

1. E.M. Trent, Theory of metal cutting. Butterworths.
2. G. Boothroyd. Fundamentals of metal machining and machine tools. Mc Graw Hill.
3. P.N. Rao, Manufacturing Technology Vol 2-Metal Cutting and Machine Tools, Tata McGraw Hill.
4. Ghosh and A.K. Mallik, Manufacturing Science, Ellis Horwood.
5. B.L. Jones, Computer Numerical Control,John Wiley and Sons.

Supplementary Reading

1. P.C. Pandey and H.S. Shan, Modern Machining Processes, McGraw-Hill.
2. G.C. Sen and A. Bhattacharya, Principles of Metal Cutting/Principles of Machine Tools, New Central Book Agency.
3. Production Technology, HMT Publication, TMH.

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	-	-	-	-	-	-	-	-	-	-	1	2	-	-
CO2	2	3	-	-	-	-	-	-	-	-	-	-	2	-	-
CO3	2	2	-	-	3	-	-	-	-	-	-	-	2	-	-
CO4	3	-	-	2	-	-	-	-	-	-	-	-	-	2	-
CO5	-	-	-	-	3	-	-	-	-	-	-	-	2	-	2
CO6	-	-	2	-	3	-	-	-	-	-	-	-	2	2	-

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Renewable Energy Sources and Applications	**Subject Code:** TIU-UME-E302A
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Explain the historical perspective of energy demand and supply, the environmental impact of fossil fuels, and the role of renewable energy in sustainable development.
2. Analyze the working principles and applications of solar thermal, photovoltaic, wind, biomass, ocean, and geothermal energy systems.
3. Apply feasibility studies for solar heating, wind energy utilization, and biomass-based rural electrification.
4. Compare different renewable energy technologies based on efficiency, advantages, and limitations for practical implementation.

COURSE OUTCOME :

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

CO1	Identify the historical trends in energy consumption, the impact of fossil fuels, and the importance of renewable energy for sustainable development.	K1
CO2	Summarize the principles, advantages, and limitations of solar thermal and photovoltaic systems for power generation and heating applications.	K2

CO3	Utilize the concepts of wind energy conversion, including turbine types, site selection, and efficiency considerations, to assess wind power potential.	K3
CO4	Examine biomass energy systems, including biogas plants and gasifiers, for rural electrification and industrial co-generation	K4
CO5	Differentiate between various ocean energy technologies, such as tidal, wave, and OTEC, based on their working principles and feasibility.	K4
CO6	Demonstrate geothermal energy applications, including direct-use and power generation, with case studies of Indian geothermal sites	K2

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**2 Hours**
Energy demand growth and supply: Historical Perspectives; Fossil fuels: Consumption and Reserve; Environmental Impacts of Burning of Fossil fuels; Sustainable Development and Role of Renewable Energy.		
MODULE 2:	**BASICS OF SOLAR ENERGY**	**3 Hours**
Solar geometry; Primary and Secondary Solar energy and Utilization of Solar Energy. Characteristic advantages and disadvantages. Low temperature applications: solar water heating, space-heating, drying, Feasibility of solar space heating for residential buildings, Feasibility of solar heating systems in rural areas		
MODULE 3:	**SOLAR THERMAL ELECTRICITY GENERATION**	**4 Hours**
Solar concentrators and tracking; Dish and Parabolic trough concentrating generating systems, Central tower solar thermal power plants; Solar Ponds, Improvement in solar concentrators using tracking systems		
MODULE 4:	**SOLAR PHOTOVOLTAIC SYSTEMS**	**7 Hours**
Basic principle of power generation in a PV cell; Band gap and efficiency of PV cells; Manufacturing methods of mono- and poly-crystalline cells, Amorphous silicon thin film cells, Single and multi-junction cells; Application of PV; Brief outline of solar, PV stand-alone system design; Storage and Balance of system, Modern advancement of Solar Photovoltaic Systems		
MODULE 5:	**WIND ENERGY SYSTEMS**	**7 Hours**
Types of turbines, Coefficient of Power, Betz limit, Wind electric generators, Power curve; wind characteristics and site selection; Wind farms for bulk power supply to grid; Potential of wind electricity generation in India and its current growth rate, Application of Low Wind and High Wind Speed Turbines		
MODULE 6:	**BIOMASS ENERGY**	**6 Hours**
Biomass: Sources and Characteristics; Wet biogas plants; Biomass gasifiers: Classification and Operating characteristics; Updraft and Downdraft gasifiers; Gasifier based electricity generating systems; Maintenance of gasifiers, Biomass gasifiers for rural electrification, biomass-based co-generation in industries		
MODULE 7:	**OCEAN ENERGY**	**5 Hours**
Tidal power plants: single basin and two basis plants, Variation in generation level; Ocean Thermal Electricity Conversion (OTEC); Electricity generation from waves: Shoreline and Floating wave systems, Small-scale wave energy converters		
MODULE 8:	**GEOTHERMAL ENERGY**	**5 Hours**
Geothermal sites in India; High temperature and Low temperature sites; Conversion technologies-Steam and Binary systems; Geothermal power plants, Case study on direct-use geothermal applications (district heating, greenhouse farming)		
TOTAL LECTURES		**39 Hours**

Books:

1. Renewable Energy Sources and Emerging Technologies D.P Kothari, K.C.Singal, Rakesh Ranjan. PHI Publication.
2. Non-Convectional Resources G.S. Sawhney; PHI Publication.
3. Non-Conventional Energy Sources by G.D. Rai, Khanna Publishers, Delhi.
4. Renewable Energy engineering and Technology: Principles and Practice, V.V.N. Kishore, TERI Press.
5. Renewable Energy Resources, Twidell J. and Weir T., Taylor &Francis
6. Renewable energy, Godfrey Boyle, Oxford 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	2	2	-	-	-	2	3	2	-	-	-	2	2	-	2
CO2	3	2	-	-	2	-	3	-	-	-	-	1	3	-	2
CO3	3	2	-	-	2	-	3	-	-	-	-	2	3	-	2
CO4	2	2	-	-	2	2	2	-	-	-	-	2	3	-	2
CO5	2	2	-	-	1	-	3	-	-	-	-	1	2	-	2
CO6	2	-	-	-	1	-	2	-	-	-	-	1	2	-	2

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Metrology andMechanical Measurement Lab	**Subject Code:** TIU-UME-L324
Contact hours/week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE:

- Understand and Apply Precision Measuring Instruments: Equip students with the knowledge and skills to effectively use and calibrate precision measuring instruments commonly used in metrology labs, such as slip gauges, dial gauges, and toolmakers' microscopes.
- Develop Practical Skills in Dimensional Measurements: Enable students to accurately build slip gauges for given dimensions and apply their understanding of calibration techniques to achieve precise measurements.
- Learn Thread Parameters Measurement Techniques: Provide students with the ability to measure thread parameters using tools such as the Tool Makers Microscope and floating carriage micrometer, understanding their application in industrial settings.
- Master Calibration Methods: Develop students' proficiency in calibrating instruments like dial gauges and sine bars to ensure accurate measurement results in various engineering applications.

- Enhance Gear and Surface Measurement Techniques: Train students to measure gear tooth thickness using a gear tooth Vernier and assess surface roughness, focusing on the importance of these measurements in quality control.
- Gain Expertise in Advanced Measurement Tools: Familiarize students with the use of modern metrology tools such as Coordinate Measuring Machines (CMM) and dial bore indicators to measure complex dimensions like bores and angles, fostering precision in engineering practices.

COURSE OUTCOME:

CO1	Apply the knowledge of metrology to maintain quality of product for the safety of Environment and society.	K2
CO2	Determine the quality of product using modern metrology tools	K3
CO3	Design a measuring equipment to produce high accuracy product	K3, K4
CO4	Calibrate various measuring equipment to maintain standards	K4
CO5	Investigate the problem in quality control and give solution with the engineering knowledge	K3

COURSE CONTENT:

MODULE 1:		**3 Hours**
Precision measuring instruments used in metrology lab – A Study		
MODULE 2:		**3 Hours**
To build up the slip gauge for given dimension– A Study		
MODULE 3:		**3 Hours**
Thread parameters measurement using Tool Makers Microscope		
MODULE 4:		**3 Hours**
Calibration of dial gauge		
MODULE 5:		**3 Hours**
Determination of taper angle by sine bar method		
MODULE 6:		**3Hours**
Determination of gear tooth thickness using gear tooth Vernier		
MODULE 7:		**3Hours**
Measurement of thread parameters using floating carriage micrometer		
MODULE 8:		**3Hours**
Measurement of various dimensions using Coordinate Measuring Machine		
MODULE 9:		**3Hours**
Measurement of surface roughness		
MODULE 10:		**3Hours**
Measurement of bores using dial bore indicator and telescopic gauge		
TOTAL LECTURES		**30 Hours**

Books:

Main Reading

1. Experimental Methods for Engineers by J.P. Holman, McGraw Hill Education (India) Private Limited.
2. Instrumentation, Measurement and Analysis by B.C. Nakra and K.K. Chaudhry, McGraw

Hill Education (India) Private Limited.

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	-	-	2	2	2	2	-	-	-	1	2	-	2
CO2	2	2	-	-	3	-	-	-	-	-	-	1	3	-	-
CO3	3	2	2	-	3	-	-	-	-	-	-	1	3	-	2
CO4	2	-	-	-	3	-	-	-	-	-	-	2	2	-	-
CO5	3	3	-	2	2	-	-	-	-	-	-	2	3	-	2

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Modelling and Simulation Using SolidWorks	**Subject Code:** TIU-UME-L310
Contact Hours/Week: 0–0–3 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE :

Enable the student to:

1. Develop 3D Modeling and Design Skills by creating and modify 3D models using SolidWorks by understanding fundamental concepts such as sketches, dimensions, relations, features, and assemblies.
2. Assemble multiple parts using various mating techniques and generate detailed technical drawings with annotations, dimensions, and bill of materials for manufacturing purposes.
3. Implement advanced modeling techniques such as loft, sweep, shell, fillets, patterns, and mirroring, as well as perform simulations for stress analysis, motion studies, and rendering.

4. Evaluate design performance through engineering analysis, compare theoretical and actual design outputs, and utilize SolidWorks tools for model optimization and automation.

COURSE OUTCOME :

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

CO1	Explore 3D design principles, SolidWorks interface, and sketching techniques for parametric modeling.	K2
CO2	Design 3D components using extrusion, lofting, sweeping, filleting, and patterning to meet industry standards.	K3
CO3	Optimize mechanical assemblies by applying mates, detecting interference, and generating exploded views.	K4
CO4	Evaluate engineering drawings with precise dimensioning, annotations, section views, and assembly documentation.	K5
CO5	Simulate mechanical designs using parametric modeling, automated updates, and SolidWorks analysis tools.	K6
CO6	Implement SolidWorks tools for feature recognition, CAD data management, and design optimization.	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION TO SOLID WORKS – FUNDAMENTALS**	**3 Hours**
Concepts on 3D design and components, Terminology; User interface; Design Process and Method, Sketches – Origin, Planes, Dimensions and Relations; Features; Assemblies; Drawings; Model Editing		
MODULE 2:	**PART DESIGN**	**6 Hours**
Overview; Design Approach, create the base feature with an extrude, add an extrude to the base, Cut- Extrude feature to remove material; Loft, Sweep, Shell, Fillet and Chamfer; Mirror in sketch and Feature; Generate a linear pattern and circular pattern; Dimensioning using smart dimensions; Insert Planes and Axes, insert helix		
MODULE 3:	**ASSEMBLIES**	**6 Hours**
Assembly definition; Prepare an assembly – Inserting Parts; Mates – Standard Mates, Advanced Mates and Mechanical Mates; Load an assembly; Examine the assembly – Hide and Show components, Explode the assembly, detect interference between components		
MODULE 4:	**DRAWINGS**	**6 Hours**
Drawing documents – Drawing templates, drawing sheets, sheet formats, drawing views; Part Drawing Sheet - Standard views, View display and alignment, Dimensions and Annotations, Section View; Assembly Drawing Sheet – Explode lines, Derived views, Notes and other annotations, Bill of Materials, Balloons and Stacked Balloons		
MODULE 5:	**ENGINEERING TASKS**	**3 Hours**
Building multiple configurations of parts; Updating models automatically; Importing and exporting features – Feature recognition; Solid works Simulation – Stress analysis; Solid works motion simulation; Rendering of parts and assemblies		
TOTAL LECTURES		**24 Hours****

Books:

1. Solidworks 2021 Reference Guide by David C. Planchard

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	2	-	-	-	3	-	-	-	-	-	-	-	2	-	-
CO2	-	-	3	-	3	-	-	-	-	-	-	-	2	-	-
CO3	-	-	3	2	-	-	-	-	-	-	-	-	-	2	2
CO4	2	-	-	-	2	-	-	-	-	-	-	-	2	-	-
CO5	2	-	-	3	-	-	-	-	-	-	-	-	-	2	2
CO6	2	-	-	-	2	-	-	-	-	-	-	-	2	-	2

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 3rd Yr., 6th Sem.
Course Title: Career Advancement and Skill Development	**Subject Code:** TIU-CASD-UTR-S302A
Contact hours/week: 0-0-2 (L-T-P)	**Credit:** 1

COURSE OBJECTIVE :
Enable the student to:

- **Develop proficiency in SAP Production Planning (PP):** Gain expertise in managing production processes, including capacity planning, material requirements planning, and production scheduling within SAP PP.
- **Master SAP Financial Accounting and Controlling (FI/CO) modules:** Acquire a comprehensive understanding of financial transactions, reporting, cost tracking, and internal controls within SAP's FI and CO modules.

- **Understand SAP Human Capital Management (HCM) functionalities:** Learn to manage employee data, payroll, recruitment, and performance evaluations effectively using SAP HCM.
- Develop proficiency in data modeling, visualization, and analytics to transform business data into actionable insights, enhancing data-driven decision-making.

COURSE OUTCOME :

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

CO1	Gain expertise in SAP architecture, core business processes, optimization, and preparation for certification.	K5
CO2	Develop proficiency in navigating SAP systems, understanding their interface, and efficiently accessing key functionalities.	K 3
CO3	Gain a foundational understanding of SAP through hands-on experience with the GBI model for business processes..	K 2
CO4	Understand and apply the Sales & Distribution business processes in SAP, including order management, pricing, shipping, and billing.	K 3
CO5	Gain expertise in the integrated Materials Management process in SAP, covering procurement, inventory management, and materials planning.	K 4

COURSE CONTENT :

MODULE 1:	Production Planning and Exaction	**10 Hours**
● Understand a manufacturing process cycle ● PP organization structure ● Master Data ● Bill of Material ● Material Requirement Planning ● Multi-Level Scheduling ● Production Order ● Material Withdraw, Conformation, Goods Receipt, Order Settlement		
MODULE 2:	Financial Accounting and Controlling	**10 Hours**
● Overview of SAP FICO ● FICO organization structure ● GL Configuration & Operation ● Create Vendor Master Data ● Cost center accounting		

MODULE 3:	Human Capital Management	10 Hours
● Overview of HR Module and Organization structure ● Organizational Management ● Personnel Administration ● Recruitment ● Performance Management ● Personnel Controlling		
MODULE 4:	**SAP Analytics Cloud**	**9 Hours**
● Introduction to SAP Analytics Cloud ● Overview of connections and its type ● Live data with CORS and Import data connection ● Creating Data modeling and Modeler navigation ● Creating storying and data exploration ● AP Analytics Cloud Analytics Designer and Microsoft Office Integration		
TOTAL		**39 Hours**

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	2	-	-	-	-	-	-	-	-	-	-	3	-	-	2
CO2	-	-	-	-	2	-	-	-	-	-	-	2	-	-	2
CO3	-	-	-	2	2	-	-	-	-	-	-	-	-	-	3
CO4	-	-	-	2	-	-	-	-	-	-	-	2	-	-	3
CO5	-	-	-	3	-	-	-	-	-	-	-	2	-	-	3

SEMESTER 7

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 4th Yr., 7th Sem.

Course Title: Operations Research and Industrial Management	**Subject Code:** TIU-UME-T413
Contact hours/week: 3-1-0 (L-T-P)	**Credit:** 4

COURSE OBJECTIVE :
Enable the student to:

- Introduce fundamental concepts and techniques of Operations Research for decision-making in complex systems.
- Develop problem-solving skills using Linear Programming, Network Flow Models, and Queuing Theory for optimization.
- Familiarize students with Industrial Management principles, including forecasting, inventory control, and production planning.
- Enhance understanding of work study, plant layout, and quality management techniques for operational efficiency.

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

CO1	Understand and apply **fundamental concepts of** Linear Programming, Transportation, and Assignment Problems **to optimize decision-making in operations research.**	K3
CO2	Analyze and evaluate **network flow models like** CPM, PERT, and GERT **for effective project planning and scheduling.**	K4,K5
CO3	Demonstrate proficiency **in** Queuing Theory, Game Theory, Markov Chains, and Monte Carlo Simulation **for decision analysis in uncertain environments.**	K3,K4
CO4	Implement forecasting techniques **and** inventory management models **such as** ABC Analysis, EOQ, and MRP **to improve production planning.**	K3,K5
CO5	Examine and optimize **work-study methods, including** time study, motion study, and method study**, to enhance productivity and efficiency.**	K4,K6
CO6	Assess and design **effective** plant layouts, Total Quality Management (TQM) strategies, and Value Analysis **for operational excellence.**	K5,K6

COURSE CONTENT :

MODULE 1:	**Linear programming**	**12 Hours**
Linear programming- graphical method, simplex method, dual simplex method; Transportation Problems: North West Corner Rule, Vogel's Approximation Method, MODI Method; Assignment problems: Hungerian Method, Travelling Salesman Problem.		
MODULE 2:	**Net Work Flow Model**	**6 Hours**
Net Work Flow Model: Critical Path Method (CPM), Project Evaluation and Review Technique (PERT), Graphical Evaluation and Review Technique (GERT).		
MODULE 3:	**Queuing theory**	**6 Hours**
Queuing theory: Game theory, Markov chain, Monte Carlo Simulation.		
MODULE 4:	**Forecasting techniques and models**	**10 Hours**
Forecasting techniques and models; Inventory control: ABC Analysis, Economic Order Quantity (EOQ) models; Materials Requirement Planning and ERP; assembly line balancing; Break Even Analysis; Lean and JIT Manufacturing System.		

MODULE 5:	**Work Study**	**4 Hours**
Work Study – Work measurement, time study, motion study, method study.		
MODULE 6:	**Total Quality Management**	**4 Hours**
Plant location and plant layout (various types); TQM; Value Analysis		
TOTAL		**42 Hours**

Recommended Books: Main Reading

1. Production Systems: Planning, Analysis and Control by J.L.Riggs, 3rd ed., Wiley.
2. Productions and Operations Management by A.Muhlemann, J.Oakland and K. Lockyer, Macmillan.
3. Operation Research (Second Edition) by A.M. Natarajan, P. Balasubramanie, A. Tamilarasi
4. Operations Research by J.K.Sharma, Macmillan.
5. Operations Research,Vijayakumar,SciTech
6. Production, Planning and Inventory Control by S.L.Narasimhan, D.W.McLeavey, J.Billington, Prentice Hall.
7. Production Systems: Planning, Analysis and Control by J.L. Riggs, 3rd ed., Wiley.
8. Industrial Engineering and Management by O.P. Khanna, Dhanpat Rai Publications

Supplementary Reading

1. Production and Operations Management by S.N. Chary. McGraw Hill Publ, 5th Edition.
2. Operations and Supply Management (SIE) by Chase. McGraw Hill Publishers, 12/e.
3. Production and Operations Management by Saxena. McGraw Hill Publishers, 2/e.

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	3	-	-	2	-	-	-	-	-	-	1	3	-	-
CO2	3	2	-	2	2	-	-	-	-	-	-	2	3	-	-
CO3	3	3	-	-	2	-	-	-	-	-	-	2	3	-	-
CO4	2	2	-	-	3	-	-	-	-	-	-	2	3	-	-
CO5	2	2	-	-	3	-	-	-	-	-	-	2	3	-	2
CO6	2	-	3	-	2	-	-	-	-	-	-	2	3	-	2

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Mechatronics and Industrial Control	**Subject Code:** TIU-UME-T415
Contact Hours/Week: 3–1–0 (L–T–P)	**Credit:** 4

COURSE OBJECTIVE :

Course Objectives for Industrial Control and Mechatronics:

- Understand fundamental concepts of industrial control systems and mechatronics.
- Analyze and design control systems for industrial automation.
- Integrate mechanical, electrical, and computing systems in mechatronics applications.
- Explore the working principles and applications of **sensors** and **actuators** in industrial automation.
- Apply **PLCs, sensors, actuators, and robotics** in automated systems.

COURSE OUTCOME :

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

CO1	Understand the fundamentals of Industrial Automation the necessity of each blocks such as (Sensing element, signal conditioning element and signal processing element) and its role in the overall instrumentation architecture.	K2
CO2	The student should understand and analyze working principle of each sensors and conditioning circuits like electrical bridges, amplifiers, filters and also signal processing circuits like A/D, D/A, quantization and Sample / Hold circuits .	K3
CO3	Understand and analyze closed loop control performance for PID algorithms (P, PI and PID). Understand and analyze Cascade, feed-forward, feed-back-feed-forward, Ratio, Selective, Split range and Inferential Control strategies for enhanced process control beyond conventional single-loop PID controllers .	K2
CO4	Understand and analyze the basics of PLC programming. Understand the different parameters of PLC.	K3
CO5	Understand and analyze real time control system	K3

COURSE CONTENT :

MODULE 1:	**Introduction**	**6 Hours**
Mechatronics: Its definition and advantages. Mechatronic systems: mechanical, electrical, electronic and computer system. Measurement systems: sensor, signal conditioning and display systems. Control systems: Open loop and close loop systems: advantages and disadvantages of open loop and closed loop systems.		
MODULE 2:	**Sensors and Transducer**	**10 Hours**

Static and Dynamic characteristics, calibration. Step and frequency response of first and second order elements and loading effect and dynamic compensation. Potentiometer, Strain gauge (Poisson's Equation, gauge factor, Mechanical Installation of strain Gauge and Types, of strain Gauge), RTD, Thermistor. Capacitor sensor, Variable reluctance sensor, Elastic sensing element (Bourdon tube, bellows and Diaphragms for pressure sensing). Deflection Bridges (Design of resistive and reactive bridges, push pull configuration for improvement of linearity and sensitivity. Operational Amplifiers (ideal and non-ideal performance, Instrumentation amplifier, Architecture of Closed loop 4-20 milliamp		
MODULE 3:	**Controller Principles:**	**9 Hours**
Control system parameters: error, range, percentage controller output, control lag, Dead time, Controller modes: Discontinues control mode (Two Position mode, Three position mode, floating mode), Continuous control mode: (Proportional, Integral and Derivative Control Mode), Composite Control Mode: (PI, PD and PID Control system), Control Structure: (Feed-forward, cascade and Ratio control).		
MODULE 4:	**Actuators: Actuation systems: Pneumatic Actuation**	**8 Hours**
Pneumatic Actuation: (Pneumatic Signals, amplification, Flapper/Nozzle systems, I/P convertor, P/I convertor, Electromechanical actuators, Control valves (Spring and Diaphragm valve), Pneumatic actuator, fail safe operation, Spring-less diaphragm Actuator, Hydraulic actuator, Electrical actuator: Solenoid, DC Motor, AC motor, switching devices (silicon controlled rectifiers, gate turn off Thyristor		
MODULE 5:	**Programmable Logic Controllers:**	**8 Hours**
PLC input and output, Operation of PLC, Difference between PLC and hardwired device, PLC architecture and concept of Ladder logic, Basic programming of PLC with simple application. PLC Timer and counter.Introdusction to real time control system .		
TOTAL LECTURES		**41 Hours**

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	-	-	2	-	-	-	-	-	-	1	2	-	-
CO2	3	2	-	-	3	-	-	-	-	-	-	1	3	-	-
CO3	3	3	-	2	2	-	-	-	-	-	-	2	3	-	2
CO4	2	-	2	-	3	-	-	-	-	-	-	2	3	-	-
CO5	2	-	3	-	2	-	-	-	-	-	-	2	3	-	2

TECHNO INDIA UNIVERSITY

W E S T B E N G A L

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Basics of Steam Power Plant	**Subject Code:** TIU-UME-T419
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE :

Enable the student to:

1. Understand the principles of Second Law of Thermodynamics, properties of pure substances, and various gas and vapor power cycles, including their applications in power generation..
2. Analyze the working of boilers, steam turbines, and condensers, including their classifications, components, efficiencies, and operational challenges in power plants.
3. Evaluate the performance of steam power plants, considering thermodynamic cycles, economic factors, and environmental impacts, including load sharing and cost analysis.
4. Design and optimize power plant systems, incorporating concepts such as reheat, regeneration, combined cycles, and auxiliary equipment for improved efficiency and sustainability.

COURSE OUTCOME :

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

CO1	Illustrate the working of a gas turbine power plant and a vapor power cycle in correlation with the Second Law of Thermodynamics and the properties of a pure substance.	K1
CO2	Determine the efficiency and output of a modern Rankine cycle steam power plant from given data, incorporating superheat, reheat, regeneration, and irreversibilities.	K3
CO3	Classify different types of coupled vapor cycles and enumerate the advantages of a combined cycle power plant.	K2
CO4	Understand the classifications of boilers, their working procedures, and associated mountings and accessories.	K2
CO5	Analyze various types of steam turbines, including their principles of operation, components, and applications, along with condensers and feed water pumps.	K4
CO6	Apply economic factors in the selection of a steam power plant, considering cost-effectiveness and operational efficiency.	K3

COURSE CONTENT :

MODULE 1:	**INTRODUCTION**	**6 Hours**
Basics of Second Law of Thermodynamics, Properties of Pure Substance, Gas Power Cycles: Stirling, Brayton cycles. Gas turbine cycles with intercooling, reheating and regeneration. Use of air tables for gas power cycle analysis.		
MODULE 2:	**VAPOUR POWER CYCLES**	**7 Hours**
Carnot cycle, Rankine cycle, Reheat cycle, Regenerative cycles, Effect of operating variables on Regenerative cycles, Availability analysis of cycles, Binary vapour cycle, Co-generative cycles,		

Combined Gas Vapour cycles		
MODULE 3:	**BOILERS**	**10 Hours**
Classification of Boilers, Fire and water-tube boilers. Mountings and Accessories of boilers. Coal analysis, Combustion calculations using both mass and energy balance, heating values. Types of coal feeding and firing methods. Introduction to power station boiler. Circulation theory and processes. Draft: Definition, classifications and calculations. Auxiliary heating surfaces: super heater, reheater, economizer, air preheater. Losses in boilers. Equivalent evaporation. Boiler efficiency. Basics of water treatment and ash handling.		
MODULE 4:	**STEAM TURBINE**	**8 Hours**
Classifications of turbines, Nozzles: types, flow through nozzles, nozzle efficiency. Impulse turbine: Flow through impulse blading, velocity diagram, work done, Blade efficiency. Multistaging of turbines: pressure compounding and velocity compounding. Impulse-Reaction turbine: Flow through impulse-reaction blading, velocity diagram, Degree of reaction, Parsons Turbine, Principle of turbine governing, Different losses in turbine, blade erosion.		
MODULE 5:	**CONDENSERS**	**4 Hours**
Classification, Elements of condensing plant, Power plant condensers, Air leakage - effect and removal		
MODULE 6:	**POWER PLANT ECONOMICS**	**4 Hours**
Load curve, load factor, utilization factor etc. Fixed and variable operating cost, Principle of load sharing.		
TOTAL LECTURES		**39 Hours**

Books:

1. Power Plant Engineering by P.K. Nag, McGraw Hill Education (India) Private Limited.
2. Power Plant Technology by M.M. El-Wakil, McGraw Hill Education (India) Private Limited.
3. Power Plant Engineering by Black & Veatch, CBS Publisher.
4.Steam & Gas Turbines and Power Plant Engineering by R. Yadav, Central Publishing House.
5. A Textbook of Power Plant Engineering by R.K. Rajput, Laxmi Publications.

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	-	-	2	-	2	-	-	-	-	1	2	-	2
CO2	3	3	-	2	2	-	-	-	-	-	-	2	3	-	-
CO3	2	2	-	-	1	-	2	-	-	-	-	1	2	-	2
CO4	2	-	2	-	2	-	-	-	-	-	-	1	2	-	-
CO5	2	2	-	-	2	-	-	-	-	-	-	1	2	-	2
CO6	2	-	2	-	1	-	-	-	-	-	2	2	2	-	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester: 4**th Yr., 7th Sem.
Course Title: Computer Aided Manufacturing	**Subject Code:** TIU-UME-E417
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

1. Understand and Apply CAM Techniques: Students will gain an understanding of computer-aided manufacturing processes, including the use of CAD/CAM software, and will be able to apply these techniques to optimize production processes and improve manufacturing efficiency.
2. Design and Simulate Manufacturing Systems: Students will develop the ability to design and simulate manufacturing systems, such as CNC machines, automated assembly lines, and robotics, using industry-standard CAM software tools.
3. Analyze and Troubleshoot CAM Systems: Students will be able to analyze the performance of CAM systems, identify potential problems, and apply troubleshooting techniques to ensure smooth and effective manufacturing operations.

Course Outcome:

CO1	Apply knowledge about various methods of communication in CIM and its importance for decision making	K2
CO2	Understand the importance of CAD in the light of allied technologies such as CAM, CAE, FEA and CFD	K2
CO3	Apply geometric transformations on the created models and solve numerical problems on transformation	K3
CO4	Understand the use of computer in manufacturing, automation and robotics	K2
CO5	Learn the working of NC, CNC and DNC machine and use of CAPP in manufacturing environment.	K3
CO6	Design flexible manufacturing cell after carrying out group technology study and finally able to create FMS.	K4

Course Content:

MODULE 1:		**12 Hours**
Concept of Computer Integrated Manufacturing (CIM), Basic components of CIM, distributed database system, distributed communication system, computer networks for manufacturing, future automated factory, social and economic factors.		

MODULE 2:		**8 Hours**
Computer Aided Design (CAD): CAD hardware and software, product modelling, automatic drafting, engineering analysis, FEM design review and evaluation, Group Technology Centre.		
MODULE 3:		**19 Hours**
Computer Aided Manufacturing (CAM): Computer assisted NC part programming, Computer assisted robot programming, computer aided process planning (CAPP), computer aided material requirement planning and MRP, computer aided production scheduling, computer aided inspection planning, computer aided inventory planning, flexible manufacturing system (FMS), concept of flexible manufacturing, Integrating NC machines, robots, AGVs, and other NC equipment, Computer aided quality control, business functions, computer aided forecasting. Management Information Systems (MIS), Various CIM systems - examples.		
TOTAL		**39 Hours**

Recommended Books:

Main Reading

1. CAD/CAM: Theory and Practice by I. Zeid and R. Sivasubramanian, McGraw Hill Education (India) Private Limited.
2. CAD/CAM: Principles and Applications by P.N. Rao, McGraw Hill Education (India) Private Limited.

Supplementary Reading

1. Principles of Computer Graphics by Donald Hearn and M. Pauline Baker. Prentice Hall, Inc.
3. Geometry for Computer Graphics and CAD by Duncan Marsh. Applied. Second Edition Springer.
4. Automation, Production systems and Computer Integrated Manufacturing Systems by Mikell P. Groover. PHI Publishers.
5. Computer Aided Design and Manufacturing by K. Lalit Narayan, K. Mallikarjuna Rao and MMM Sarcar. PHI Publishers.
6. Computer aided Manufacturing by Chang, T. C., Wysk, R. A. and Wang, H. P. Prentice Hall.
7. Systems Approach to Computer Integrated Design and Manufacturing by Nanua Singh. John Wiley and Sons Ltd.

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	2	2	-	-	2	-	-	-	-	-	-	1	3	-	-
CO2	2	-	-	-	3	-	-	-	-	-	-	1	2	-	-
CO3	3	2	-	-	3	-	-	-	-	-	-	1	3	-	-
CO4	2	2	-	-	2	-	-	-	-	-	-	1	3	-	-
CO5	2	-	2	-	3	-	-	-	-	-	-	1	3	-	2
CO6	2	-	2	-	2	-	-	-	-	-	-	2	3	-	2

TECHNO INDIA UNIVERSITY
WEST BENGAL
Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Industrial Training	**Subject Code:** TIU-UME- L403
Contact Hours/Week: 0–0–0 (L–T–P)	**Credit:** Practical–1.5
Prerequisite Course: Theory and practical subjects of Mechanical Engineering	

Course Objective

Enable the students to

1. Improve their knowledge and skills relevant to their areas of specialization.
2. Relate, apply and adapt relevant knowledge, concepts and theories within an industrial organization, practice and ethics.
3. Acquire knowledge and skills to compete in the job market with this experience and exposure.

Course Outcome

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

CO1	apply the knowledge and skills they have acquired on campus in a real-life work situation	K3
CO2	Develop knowledge of contemporary issues	K2
CO3	expose students to a work environment, common practices, employment opportunities and work ethics in their relevant field	K4
CO4	Develop written communication and technical report writing skills	K6
CO5	enhance the employability skills of the students	K5
CO6	provide opportunities for students to be offered jobs in the organizations in which they undergo their Industrial Training	K3

Course Content

Industrial Training of four weeks at an Institute approved organization to be done during vacation in Semester VI, credit to be given in Semester VII. Students shall have to submit a report endorsed by the Industry Training Manager/ Lab-in-charge of R&D organization.

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	2	2	-	-	2	-	-	-	3	-	2	2	3	-	2
CO2	–	2	-	-	–	2	2	–	–	–	–	2	2	–	–
CO3	–	–	–	–	–	2	–	2	3	–	–	2	2	–	–
CO4	–	–	–	–	–	–	–	–	–	3	–	1	–	–	–
CO5	–	–	–	–	–	–	–	–	3	–	3	2	–	–	2
CO6	–	–	–	–	–	–	–	–	2	–	–	1	–	–	–

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: B. Tech Project I	**Subject Code:** TIU-UME-P403
Contact hours/week: 0-0-3 (L-T-P)	**Credit:** 1.5

COURSE OBJECTIVE :
Enable the student to:

- To enhance students ability to identify, formulate, and analyze engineering problems by conducting literature surveys, exploring recent industry trends, and applying fundamental principles of science and engineering.
- To equip students with the skills to prepare comprehensive project reports, deliver effective presentations, and confidently handle technical reviews and viva voce examinations.

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

CO1	Analyze and formulate complex engineering problems by conducting literature reviews, understanding industry trends, and applying fundamental scientific and engineering principles.	K4
CO2	Develop innovative solutions or conduct independent research in specialized areas of Mechanical Engineering, demonstrating creativity in design and analysis.	K6
CO3	Apply appropriate methodologies to prepare well-structured and technically sound project reports that meet academic and professional standards.	K3
CO4	Evaluate and present project findings effectively, articulating ideas clearly and confidently to an expert evaluation board.	K5
CO5	Apply knowledge from various mechanical engineering disciplines (Heat Power, Fluid Mechanics, Machine Design, Applied Mechanics, and Production) to solve real-world problems.	K3
CO6	Interpret feedback from supervisors and evaluation panels, critically assess project outcomes, and refine approaches for continuous improvement.	K5

COURSE CONTENT :
Each student has to work on a research topic or advanced design and analysis project for two semesters. The evaluation is to be carried out in each semester separately. The project can be selected from different specialization branches related to Mechanical Engineering (Heat Power/Fluid Mechanics/Machine Design/ Applied Mechanics/ Production). A list of topics will be offered by the department. Students have to submit a project report to the respective supervisors and give a presentation of the work done in front of a specialization specific evaluation board.

Reference:

1. Any Journals or Books

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	3	-	2	2	-	-	-	-	-	-	2	3	-	2
CO2	2	-	3	2	3	-	-	-	-	-	-	2	3	-	2
CO3	–	–	–	–	–	–	–	–	–	2	–	1	–	–	–
CO4	–	–	–	–	–	–	–	–	2	3	–	1	–	–	–
CO5	3	2	–	–	2	–	–	–	–	–	–	2	3	–	2
CO6	–	–	–	–	–	–	–	–	–	–	–	2	–	–	–

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 4th Yr., 7th Sem.
Course Title: Career Advancement & Skill Development	**Subject Code:** TIU-UME-S409
Contact Hours/Week: 2–0–0 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE :
Enable the student to:

- get a grasp of the syllabus for GATE examination
- be acquainted with questions which are typically set in the GATE examination
- be acquainted with the techniques of technical writing and technical presentations

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

CO1	get a basic knowledge of Maths questions typically set in the GATE exam	K4
CO2	be acquainted with the different methods of solving problems from the broad area of Applied Mechanics and Design	K4
CO3	be acquainted with the different methods of solving problems from the broad area of Fluid Mechanics and Thermal Sciences	K4
CO4	get accustomed with the methods of solving problems in Manufacturing Science and Technology	K2
CO5	come up with good quality technical writing on any suitable topic	K2
CO6	make good quality and appealing technical presentations	K2

COURSE CONTENT :

MODULE 1:	**MATHEMATICS FOR GATE (MECHANICAL ENGINEERING)**	**12 Hours**
Matrix algebra, systems of linear equations, eigen values and eigen vectors, first order and higher order differential equations with constant coefficients, Laplace transforms, evaluation of definite and improper integrals, double and triple integrals, Vector calculus: Green, Gauss and Stokes' theorems, Fourier series		
MODULE 2:	**APPLIED MECHANICS AND DESI|GN**	**12 Hours**
Engineering Mechanics: Force systems, equilibrium, trusses, centroids, friction, kinematics and dynamics of rigid bodies executing plane motion, impulse and momentum, work and energy, axial deformation of bars, torsion of shafts, beam bending and deflection, Castigliano's theorems, free and forced vibrations of SDOF systems, cams, gears and gear trains, S-N curve, principles of design of machine elements such as bolted, riveted, welded joints, brakes and clutches		
MODULE 3:	**FLUID MECHANICS AND THERMAL SCIENCES**	**10 Hours**
Fluid statics and kinematics, equations of continuity and momentum, Bernoulli's equation, viscous		

flows, head losses in pipes, bends and fittings, 1D heat conduction, heat transfer through fins, free and forced convection, dimensionless parameters, heat exchangers LMTD and NTU methods, Stefan Boltzmann's laws, Wien's displacement law, view factors, radiation network analysis, thermodynamics systems and processes, behaviour of ideal and real gases, zeroth, first and second laws of Thermodynamics, thermodynamic relations		
MODULE 4:	**MANUFACTURING ENGINEERING**	**7 Hours**
Limits, fits and tolerances, linear and angular measurements, comparators and interferometry, basic components of CAD/CAM, additive manufacturing, deterministic models, safe stock inventory control systems		
MODULE 5:	**TECHNICAL WRITING AND PRESENTATION**	**4 Hours**
Nuances of technical writing and presentation, appealing ppt presentation methods, writing skills and pedagogy		
TOTAL LECTURES		**45 Hours**

Books:

1. GATE Mechanical Engineering, Chapterwise Previous Years' solved papers, Arihant ISBN: 9789359987033
2. Technical Writing, B.N. Basu, Prentice-Hall of India, ISBN: 9788120333345

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	3	–	–	–	–	–	–	–	–	–	2	3	–	–
CO2	3	2	–	–	2	–	–	–	–	–	–	2	3	–	2
CO3	3	2	–	–	2	–	–	–	–	–	–	2	3	–	2
CO4	3	2	–	–	3	–	–	–	–	–	–	2	3	–	2
CO5	–	–	–	–	–	–	–	–	2	3	–	2	–	–	–
CO6	–	–	–	–	–	–	–	–	3	3	–	2	–	–	–

SEMESTER 8

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 4th Yr., 8th Sem.
Course Title: Renewable Energy Sources	**Subject Code:** TIU-UME-E410
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3

COURSE OBJECTIVE:

Enable the student to:

- Explain the growth of energy demand and supply, the environmental consequences of fossil fuel consumption, and the significance of renewable energy in sustainable development.
- Differentiate between various solar energy technologies, including thermal and photovoltaic systems, and assess their efficiency, advantages, and applications.
- Examine the principles and operational characteristics of wind, biomass, ocean, and geothermal energy systems, and compare their feasibility for power generation.
- Develop optimized renewable energy solutions, integrating conversion technologies, storage mechanisms, and grid compatibility to enhance sustainability.

COURSE OUTCOME:

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

CO1	Describe the historical perspectives of energy demand and supply, the environmental impacts of fossil fuels, and the role of renewable energy in sustainable development	K1
CO2	Explain the principles of solar energy utilization, including solar geometry, thermal electricity generation, and photovoltaic systems, along with their advantages and limitations.	K2
CO3	Classify different wind energy systems, analyze wind characteristics, and compare site selection criteria for optimal energy generation.	K2
CO4	Illustrate the working principles and operational characteristics of biomass energy systems, including biogas plants and gasifiers, for electricity generation.	K3
CO5	Examine ocean energy conversion methods such as tidal, wave, and ocean thermal energy, evaluating their feasibility for power generation.	K4
CO6	Analyze the potential and efficiency of geothermal energy systems, identifying suitable conversion technologies and applications in power generation.	K4

COURSE CONTENT:

MODULE 1:	**INTRODUCTION**	**2 Hours**
Energy demand growth and supply: Historical Perspectives; Fossil fuels: Consumption and Reserve; Environmental Impacts of Burning of Fossil fuels; Sustainable Development and Role of Renewable Energy		
MODULE 2:	**SOLAR ENERGY BASICS**	**3 Hours**
Solar geometry; Primary and Secondary Solar energy and Utilization of Solar Energy. Characteristic advantages and disadvantages. Low temperature applications: solar water heating, space-heating, drying		
MODULE 3:	**SOLAR THERMAL ELECTRICITY GENERATION**	**4 Hours**
Solar concentrators and tracking; Dish and Parabolic trough concentrating generating systems, Central tower solar thermal power plants; Solar Ponds		
MODULE 4:	**SOLAR PHOTOVOLTAIC SYSTEMS**	**7 Hours**
Basic principle of power generation in a PV cell; Band gap and efficiency of PV cells; Manufacturing methods of mono- and poly-crystalline cells, Amorphous silicon thin film cells, Single and multi-junction cells; Application of PV; Brief outline of solar, PV stand-alone system design; Storage and Balance of system		
MODULE 5:	**WIND ENERGY SYSTEMS**	**7 Hours**
Types of turbines, Coefficient of Power, Betz limit, Wind electric generators, Power curve; wind characteristics and site selection; Wind farms for bulk power supply to grid; Potential of wind electricity generation in India and its current growth rate		
MODULE 6:	**BIOMASS ENERGY**	**6 Hours**
Biomass: Sources and Characteristics; Wet biogas plants; Biomass gasifiers: Classification and Operating characteristics; Up draft and Down draft gasifiers; Gasifier based electricity generating systems; Maintenance of gasifiers		
MODULE 7:	**OCEAN ENERGY**	**5 Hours**
Tidal power plants: single basin and two basis plants, Variation in generation level; Ocean Thermal Electricity Conversion (OTEC); Electricity generation from waves: Shoreline and Floating wave systems		
MODULE 8:	**GEOTHERMAL ENERGY**	**5 Hours**
Geothermal sites in India; High temperature and Low temperature sites; Conversion technologies-Steam and Binary systems; Geothermal power plants		
TOTAL LECTURES		**39 Hours**

Books:

1. Renewable Energy Sources and Emerging Technologies D.P Kothari, K.C.Singal, Rakesh Ranjan. PHI Publication.
2. Non-Convectional Resources G.S. Sawhney; PHI Publication.
3. Non-Conventional Energy Sources by G.D. Rai, Khanna Publishers, Delhi.
4. Renewable Energy engineering and Technology: Principles and Practice, V.V.N. Kishore, TERI Press.
5. Renewable Energy Resources, Twidell J. and Weir T., Taylor &Francis
6. Renewable energy, Godfrey Boyle, Oxford 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	2	2	–	–	1	2	3	2	–	–	–	2	2	–	2
CO2	3	2	–	–	2	–	3	–	–	–	–	1	3	–	2
CO3	3	2	–	–	2	–	3	–	–	–	–	2	3	–	2
CO4	2	2	–	–	2	2	2	–	–	–	–	2	3	–	2
CO5	2	2	–	–	1	–	3	–	–	–	–	1	2	–	2
CO6	2	–	–	–	1	–	2	–	–	–	–	1	2	–	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech. in Mechanical Engineering	**Year, Semester:** 4th Yr., 8th Sem.
Course Title: Additive Manufacturing	**Subject Code:** TIU-UME- E412
Contact Hours/Week: 3–0–0 (L–T–P)	**Credit:** 3
Prerequisite Course: Material Science (TIU-UME-T217); Manufacturing Processes (TIU-UME-T218); Conventional and Nonconventional Machining Technology (TIU-UME-T315)	

Course Objective

Enable the students to

- understand the fundamentals and methodologies of additive manufacturing
- develop technical proficiency in am file formats and processing techniques
- apply additive manufacturing in industry and research

Course Outcome

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

CO1	Familiarity with additive manufacturing	K1
CO2	Concept of pre-processing techniques used in additive manufacturing	K2
CO3	Describe different additive manufacturing techniques	K2
CO4	Able to investigate and select a appropriate process and materials used in additive manufacturing	K4
CO5	Able to solve problems related to additive manufacturing	K3
CO6	Able to apply knowledge of additive manufacturing for various real-life applications	K3

Course Content

MODULE 1:	**Introduction**	**6 Hours**
Definition of Additive Manufacturing, Additive Manufacturing as a natural process, Comparison of additive manufacturing with other Manufacturing Processes, Evolution of Additive manufacturing as a manufacturing process, Additive manufacturing Methodology, Pre-processing, processing, post-processing, Advantages and Limitations of Additive manufacturing, Sustainability, and classification of Additive Manufacturing.		
MODULE 2:	**Additive Manufacturing Data formats and Pre-Processing**	**6 Hours**
Additive Manufacturing File Formats: STL file format, Model slicing, Contour Generations, Tool Path Generation and Build File Preparations.		
MODULE 3:	**Additive Manufacturing Methods**	**12 Hours**
3D-printing, Stereo-lithography apparatus (SLA), Fused deposition modeling (FDM), Laminated Object Manufacturing (LOM), Selective deposition lamination (SDL), Ultrasonic consolidation, Selective laser sintering (SLS), Laser engineered net shaping (LENS), Electron beam free form fabrication (EBFFF), Electron beam melting (EBM), Plasma transferred arc additive manufacturing (PTAAM), Tungsten inert gas additive manufacturing (TIGAM), Metal inert gas additive		

manufacturing (MIGAM).		
MODULE 4:	**Applications of Additive Manufacturing**	**15 Hours**
Application Case Studies: Aerospace, Defense, Automobile, Bio-Medical, Rapid Tooling, Reverse Engineering.		
TOTAL LECTURES		**39 Hours**

Recommended Books:

Main Reading

1. C.P. Paul and A.N. Janoop, Additive Manufacturing: Principles, Technologies and Applications, McGraw Hill Education (India) Pvt. Ltd.
2. Gibson, D.W. Rosen, and B. Stucker, Additive Manufacturing Technologies, Springer.
3. C.K. Chua, K.F. Leong, and C.S. Lim, Rapid Prototyping: Principles and Applications, World Scientific Publishers.

Supplementary Reading

1. P.K. Venuvinod, and W. Ma, Rapid Prototyping: Laser-Based and Other Technologies, Springer.
2. M. Burns, Automated fabrication, Prentice-Hall.

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	2	–	–	–	2	–	–	–	–	–	–	1	2	–	–
CO2	2	–	–	–	3	–	–	–	–	–	–	1	2	–	–
CO3	3	2	–	–	2	–	–	–	–	–	–	1	3	–	–
CO4	2	2	3	–	2	–	–	–	–	–	–	2	3	–	2
CO5	3	3	–	2	2	–	–	–	–	–	–	2	3	–	2
CO6	2	–	2	–	2	–	–	–	–	–	–	2	3	–	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 4th Yr., 8th Sem.
Course Title: B. Tech Project II	**Subject Code:** TIU-UME-P404
Contact hours/week: 0-0-6 (L-T-P)	**Credit:** 3

COURSE OBJECTIVE:
Enable the student to:

- To enhance students ability to identify, formulate, and analyze engineering problems by conducting literature surveys, exploring recent industry trends, and applying fundamental principles of science and engineering.

- To equip students with the skills to prepare comprehensive project reports, deliver effective presentations, and confidently handle technical reviews and viva voce examinations.

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

CO1	Analyze and formulate complex engineering problems by conducting literature reviews, understanding industry trends, and applying fundamental scientific and engineering principles.	K4
CO2	Develop innovative solutions or conduct independent research in specialized areas of Mechanical Engineering, demonstrating creativity in design and analysis.	K6
CO3	Apply appropriate methodologies to prepare well-structured and technically sound project reports that meet academic and professional standards.	K3
CO4	Evaluate and present project findings effectively, articulating ideas clearly and confidently to an expert evaluation board.	K5
CO5	Apply knowledge from various mechanical engineering disciplines (Heat Power, Fluid Mechanics, Machine Design, Applied Mechanics, and Production) to solve real-world problems.	K3
CO6	Interpret feedback from supervisors and evaluation panels, critically assess project outcomes, and refine approaches for continuous improvement.	K5

COURSE CONTENT :
Each student has to work and complete the research topic or advanced design and analysis project for two semesters. The evaluation is to be carried out in each semester separately. The project can be selected from different specialization branches related to Mechanical Engineering (Heat Power/Fluid Mechanics/Machine Design/ Applied Mechanics/ Production). A list of topics will be offered by the

department. Students have to submit a project report to the respective supervisors and give a presentation of the work done in front of a specialization specific evaluation board.

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	3	–	2	–	–	–	–	–	–	–	2	3	2	–
CO2	2	–	3	3	–	–	–	–	–	–	–	2	3	–	2
CO3	–	–	2	2	3	–	–	–	–	2	–	–	2	3	–
CO4	–	–	–	–	–	–	–	–	2	3	–	–	2	–	–
CO5	3	2	–	–	2	–	–	–	–	–	–	2	3	–	3
CO6	–	–	–	2	–	–	–	2	–	2	–	3	2	–	2

TECHNO INDIA UNIVERSITY
WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 4th Yr., 8th Sem.
Course Title: Grand Viva Voce	**Subject Code:**TIU-UME-S496
Contact Hours/Week: 0–0–0 (L–T–P)	**Credit:** 1.5

COURSE OBJECTIVE:
Enable the student to:

1. Consolidate and integrate theoretical and practical knowledge acquired throughout the B. Tech Mechanical Engineering program, ensuring a strong foundation in core subjects.
2. Enhance analytical and problem-solving skills by applying fundamental engineering principles to real-world scenarios and technical challenges.
3. Develop confidence and effective technical communication by articulating clear, precise, and well-structured responses in a viva voce examination setting
4. Encourage interdisciplinary thinking and industry awareness by connecting theoretical concepts to modern engineering applications, advancements, and emerging technologies.

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

CO1	Recall the fundamental concepts from core mechanical engineering subjects, demonstrating a strong theoretical foundation.	K1
CO2	Apply the engineering principles to solve numerical problems and real-world mechanical systems	K3
CO3	Evaluate and troubleshoot practical engineering problems by integrating interdisciplinary knowledge from various mechanical engineering domains.	K5
CO4	Communicate the technical concepts, project findings, and problem-solving approaches confidently in a viva voce setting	K2
CO5	Critically assess and compare different mechanical engineering methodologies, materials, and manufacturing processes for optimal engineering solutions	K4
CO6	Synthesize and propose innovative solutions to engineering challenges by leveraging modern advancements and industry trends.	K6

COURSE CONTENT:

Each student will have to appear at a viva voce examination in front of a board of examiners comprising of faculty members from all the specializations on all subjects completed during the course of his/her undergraduate study. For B. Tech Mechanical covers core subjects, including **Engineering Mechanics, Strength of Materials, Theory of Machines, Fluid Mechanics, Thermodynamics, Heat Transfer, Manufacturing Processes, and Machine Design**. The viva		

assesses fundamental concepts, problem-solving skills, and real-world applications. Students should be prepared for theoretical questions, numerical problems, and discussions on projects or research work. A strong grasp of practical applications, industry advancements, and interdisciplinary topics is essential for success.

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	–	–	–	–	–	–	–	–	–	–	3	–	–
CO2	2	3	–	–	2	–	–	–	–	–	–	–	3	–	–
CO3	2	2	–	2	–	–	–	–	–	–	–	–	3	–	2
CO4	–	–	–	–	–	–	–	–	2	3	–	–	2	–	–
CO5	–	–	2	–	3	–	–	–	–	–	–	–	2	–	3
CO6	–	–	3	2	–	–	–	–	–	–	–	3	3	–	–

TECHNO INDIA UNIVERSITY

WEST BENGAL

Department of Mechanical Engineering

Program: B. Tech in Mechanical Engineering	**Year, Semester:** 4th Yr., 8th Sem.
Course Title: Career Advancement and Skill Development	**Subject Code:** TIU-UME-S402
Contact Hours/Week: 2–0– 0 (L–T–P)	**Credit:** 2

COURSE OBJECTIVE:

Enable the student to:

1. Identify and formulate two topics in a chosen area of Mechanical Engineering.
2. Conduct an in-depth literature survey on the topics
3. Come up with two comprehensive reports not exceeding 2000 words on each of those topics.

COURSE OUTCOME:

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

CO1	Define 2 topics in a preferred area of specialization.	K2
CO2	Formulate the problem statements with clear objectives.	K4
CO3	Investigate the relevant body of literature on those topics.	K4
CO4	Prepare two comprehensive reports on the two topics.	K6
CO5	Present the findings in class using the ppt mode.	K4
CO6	Participate in discussions following individual presentations.	K4

COURSE CONTENT:

		30 Hours
Each student will be required to submit to the class teacher at least two different articles containing about 2000 words on two different engineering topics of their choice, and will be required to give concise talks on those topics in the class according to the direction of the class teacher, and will have to participate in the discussion on such talks of other students also. The result of those assignments will be evaluated critically and grading would be given accordingly. This will equip the students with requisite abilities to execute their undergraduate project work concomitantly		
TOTAL LECTURES		**30 Hours**

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	–	–	–	–	–	–	–	–	–	–	–	–	2	–	–
CO2	2	2	–	–	–	–	–	–	–	–	–	–	3	–	–
CO3	2	2	–	3	–	–	–	–	–	–	–	2	3	–	–
CO4	–	–	–	–	–	–	–	–	–	2	–	–	–	–	–
CO5	–	–	–	–	–	–	–	–	2	3	–	–	–	–	–
CO6	–	–	–	–	–	–	–	–	3	2	–	–	–	–	–