ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
(Autonomous)
Course structure for Four Year Regular B.Tech. Degree Program
(Effective for the batches admitted from 2023-24)
MECHANICAL ENGINEERING (ME)

INDUCTION PROGRAMME

S. No	Course Name	Category	L-T-P-C
1	Physical Activities--Sports, Yoga and Meditation, Plantation	MC	0-0-6-0
2	Career Counselling	MC	2-0-2-0
3	Orientation to all branches –career options, tools, etc.	MC	3-0-0-0
4	Orientation on admitted Branch—corresponding labs, tools and platforms	EC	2-0-3-0
5	Proficiency Modules & Productivity Tools	ES	2-1-2-0
6	Assessment on basic aptitude and mathematical skills	MC	2-0-3-0
7	Remedial Training in Foundation Courses	MC	2-1-2-0
8	Human Values & Professional Ethics	MC	3-0-0-0
9	Communication Skills –focus on Listening, Speaking, Reading, Writing skills	BS	2-1-2-0
10	Concepts of Programming	ES	2-0-2-0

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B. Tech – I Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	BS	23ABS9903	Engineering Physics	3	0	0	3	30	70	100
2	BS	23ABS9904	Linear Algebra & Calculus	3	0	0	3	30	70	100
3	ES	23AES0201	Basic Electrical & Electronics Engineering	3	0	0	3	30	70	100
4	ES	23AES0301	Engineering Graphics	1	0	4	3	30	70	100
5	ES	23AES0501	Introduction to Programming	3	0	0	3	30	70	100
6	ES	23AES0503	IT Workshop	0	0	2	1	30	70	100
7	BS	23ABS9908	Engineering Physics Lab	0	0	2	1	30	70	100
8	ES	23AES0202	Electrical & Electronics Engineering Workshop	0	0	3	1.5	30	70	100
9	ES	23AES0502	Computer Programming Lab	0	0	3	1.5	30	70	100
10	HM	23AHM9904	NSS/NCC/Scouts & Guides/Community Service	-	-	1	0.5	50	-	50
			Total	13	00	15	20.5			**950**

B. Tech – I Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	HM	23AHM9901	Communicative English	2	0	0	2	30	70	100
2	BS	23ABS9902	Engineering Chemistry	3	0	0	3	30	70	100
3	BS	23ABS9905	Differential Equations &Vector Calculus	3	0	0	3	30	70	100
4	ES	23AES0101	Basic Civil & Mechanical Engineering	3	0	0	3	30	70	100
5	PC	23APC0101	Engineering Mechanics	3	0	0	3	30	70	100
6	HM	23AHM9902	Communicative English Lab	0	0	2	1	30	70	100
7	BS	23ABS9907	Engineering Chemistry Lab	0	0	2	1	30	70	100
8	ES	23AES0302	Engineering Workshop	0	0	3	1.5	30	70	100
9	PC	23APC0301	Engineering Mechanics Lab	0	0	3	1.5	30	70	100
10	HM	23AHM9903	Health and wellness, Yoga and Sports	-	-	1	0.5	50	-	50
			Total	14	0	11	19.5			950

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B. Tech – II Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	BS	23ABS9911	Numerical Methods &Transform Techniques	3	0	0	3	30	70	100
2	HM	23AHM9905	Universal Human Values	2	1	0	3	30	70	100
3	ES	23AES0303	Thermodynamics	2	0	0	2	30	70	100
4	PC	23APC0302	Mechanics of Solids	3	0	0	3	30	70	100
5	PC	23APC0303	Material Science and Metallurgy	3	0	0	3	30	70	100
6	PC	23APC0304	Mechanics of Solids and Materials Science Lab	0	0	2	1	30	70	100
7	PC	23APC0305	Computer-Aided Machine Drawing	0	0	3	1.5	30	70	100
8	ES	23AES0402	Embedded Systems and IoT	0	0	3	1.5	30	70	100
9	SC	23ASC0501	Python programming	0	1	2	2	30	70	100
			Total	**14**	**2**	**8**	**20**	**270**	**630**	**900**

B. Tech – II Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	HM	23AHM0301	Industrial Management	2	0	0	2	30	70	100
2	BS	23ABS9914	Complex Variables, Probability and Statistics	3	0	0	3	30	70	100
3	PC	23APC0306	Manufacturing processes	3	0	0	3	30	70	100
4	PC	23APC0307	Fluid Mechanics & Hydraulic Machines	3	0	0	3	30	70	100
5	PC	23APC0308	Theory of Machines	3	0	0	3	30	70	100
6	PC	23APC0309	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5	30	70	100
7	PC	23APC0310	Manufacturing processes Lab	0	0	3	1.5	30	70	100
8	SC	23ASC9901	Soft Skills	0	1	2	2	30	70	100
9	ES	23AES0304	Design Thinking & Innovation	0	1	2	2	30	70	100
10	MC	23AMC9901	Environmental Science	2	0	0	-	30	-	30
			Total	**16**	**2**	**10**	**21**	**300**	**630**	**930**

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B. Tech – III Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	PC		Applied Thermodynamics	3	0	0	3	30	70	100
2	PC		Theory of Machines	3	0	0	3	30	70	100
3	PC		Operation Research	3	0	0	3	30	70	100
4	PE-I		Non-Destructive Testing/ Automation & Robotics/ 3D Printing Technology.	3	0	0	3	30	70	100
5	OE-I		Non-Conventional Sources of Energy/ Smart Materials/ NEMS and MEMS.	3	0	0	3	30	70	100
6	PC		Thermal Engineering Lab	0	0	3	1.5	30	70	100
7	PC		Machine Dynamics Lab	0	0	3	1.5	30	70	100
8	SC		Soft skills & Interview	0	1	2	2	30	70	100
9	ES		Tinkering Lab	0	0	2	1	30	70	100
10			Community Service Internship	-	-	-	2	-	-	100
			Total	**15**	**1**	**10**	**23**	**270**	**630**	**1000**

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B. Tech – III Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	PC		Machining Science & Machine Tools	3	0	0	3	30	70	100
2	PC		Metrology & Measurements	3	0	0	3	30	70	100
3	PC		Design of Machine Members	3	0	0	3	30	70	100
4	PE-II		Automobile Engineering / Total Quality Management / Refrigeration & Air Conditioning	3	0	0	3	30	70	100
5	PE-II		Mechatronics/ Design of Hydraulics & Pneumatics/ Tool Design	3	0	0	3	30	70	100
6	OE-II		Product Design & Development/ Introduction to Composite Materials/ Supply Chain Management	3	0	0	3	30	70	100
7	PC		Machine Tools Lab	0	0	3	1.5	30	70	100
8	PC		Metrology & Measurements Lab	0	0	3	1.5	30	70	100
9	SC		Geometric Dimensioning & Tolerancing	0	1	2	2	30	70	100
10	MC		Technical Paper Writing & IPR	2	0	0	-	30	-	30
			Total	**20**	**1**	**08**	**23**	**300**	**630**	**930**

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MECHANICAL ENGINEERING (ME)

B. Tech – IV Year I Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	PC		Heat Transfer Heat transfer lab	2 0	0 0	0 2	2 1	30	70	100
2	HM		To be decided by H&S dept	2	0	0	2	30	70	100
3	PE-IV		Mechanical Vibrations / Power Plant Engineering / Finite Element Methods	3	0	0	3	30	70	100
4	PE-V		Design for Manufacturing/ Modern Manufacturing Methods/ Production & Operations Management.	3	0	0	3	30	70	100
5	OE-III		Energy auditing / Optimization through MATLAB/ Nano Sciences & Nano Materials	3	0	0	3	30	70	100
6	OE-IV		Programming & Control of Robots / Customer Relationship-Management / Electrical vehicles	3	0	0	3	30	70	100
7	SC		CAD/CAM/CAE Lab	0	1	2	2	30	70	100
8	AC		Constitution of India	2	0	0	-	30	70	100
9			Evaluation of Industry Internship	-	-	-	2	30	70	100
			Total	**14**	**2**	**8**	**20**	**270**	**630**	**900**

B. Tech – IV Year II Semester

Sl. No.	Category	Course Code	Course Title	Hours per week			Credits	CIE	SEE	Total
				L	T	P	C			
1	Internship & Project Work		Full semester Internship & Project Work	-	-	24	12	-	-	200
			Total	-	-	**24**	**12**	-	-	**200**

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T/CLC	P	Credits
23ABS9903	Engineering Physics	4	2	0	3

Course Outcomes:

CO: 1 Understand the intensity variation of light due to interference, diffraction, and polarization.
CO: 2 Analyze the fundamentals of crystallography and X-ray diffraction.
CO: 3 Apply the basic concepts of dielectric and magnetic materials for engineering applications.
CO: 4 Analyze the fundamentals of Quantum mechanics and interpret the nanomaterials for engineering problems.
CO: 5 Analyze the charge carrier dynamics in semiconductors by implementing the equations of state

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The intensity variation of light due to interference, diffraction, and polarization.			L2
CO2	Analyze	The fundamentals of crystallography and X-ray diffraction.			L4
CO3	Apply	The basic concepts of dielectric and magnetic materials		for engineering applications.	L3
CO4	Analyze	The fundamentals of Quantum mechanics and interpret the nanomaterials		for engineering problems.	L4
CO5	Analyze	The charge carrier dynamics in semiconductors.	by implementing the equations of state.		L4

Unit I:

Introduction: Basic Concepts: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility.

Unit II

Energy in State and in Transition, Types, Work and Heat, Point and Path function. Zeroth Law of Thermodynamics – PMM-I, Joule's Experiment – First law of Thermodynamics and applications. Limitations of the First Law – Enthalpy, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance.

Unit III

Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM-II, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

Unit IV

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Unit V

Introduction to Refrigeration: working of Air, Vapour compression, VCR system Components, COP Refrigerants.

Introduction to Air Conditioning: Psychrometric properties & processes – characterization of sensible and latent heat loads – load concepts of SHF.

Requirements of Air standard cycles and vapour Cycles.

Text Books:

1. P.K. Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009.

Reference Books:

1. J.B. Jones, and R.E. Dugan, Engineering Thermodynamics, 1/e, Prentice Hall, 1995.
2. Y.A. Cengel & M.A. Boles, Thermodynamics – An Engineering Approach, 7/e, McGraw Hill, 2010.
3. P. Chattopadhyay, Engineering Thermodynamics, 1/e, Oxford University Press, 2011.
4. CP Arora, Refrigeration and Air-conditioning, 4/e, McGraw Hill, 2021.

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Physics	CO1	3												
	CO2	3												
	CO3	3			3									
	CO4	3												
	CO5	3			3									

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	15	22.3	3	Understand	L2	PO1	PO1: Apply (L3)	2
2	11	16.4	2	Analyze	L4	PO1	PO1: Apply (L3)	3
3	12	17.9	2	Apply	L3	PO1, PO4	PO1, PO4: Apply (L3)	3
4	13	19.4	2	Analyze	L4	PO1	PO1: Apply (L3)	3
5	16	23.8	3	Analyze	L4	PO1, PO4	PO1, PO4: Apply (L3)	3
Total	**67**							

Justification Statements:

CO1: The intensity variation of light due to interference, diffraction, and polarization.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is lesser than PO1 verb by one level; Therefore, correlation is moderate (2).
CO2: The fundamentals of crystallography.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO2 Action Verb is greater than PO1 verb; Therefore correlation is high (3).
CO3: Apply the basic concepts of dielectric and magnetic materials for engineering applications.

Action Verb: Apply (L3)

PO1 and PO4 Verbs: Apply (L3)

CO3 Action Verb level is equal to PO1 and PO4 verb; Therefore correlation is high (3).

CO4: The fundamentals of Quantum mechanics and interpret the nanomaterials for engineering problems.

Action Verb: Analyze (L4)

PO1 Verb: Apply (L3)

CO4 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).

CO5: The charge carrier dynamics in semiconductors by implementing the equations of state.

Action Verb: Analyze (L4)

PO1 and PO4 Verb: Apply (L3)

CO5 Action verb is greater than PO1 verb; therefore, the correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T/CLC	P	Credits
23ABS9904	Linear Algebra and Calculus	4	2	0	3

Course Outcomes:

CO: 1 Analyze the matrix algebraic techniques for engineering applications.
CO: 2 Understand the concept of Eigen values, Eigen vectors and quadratic forms.
CO: 3 Analyze the mean value theorems for real time applications.
CO: 4 Apply the concepts of partial differentiation to functions of several variables.
CO: 5 Apply the multivariable integral calculus for computation of Area and Volume.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the matrix algebraic techniques	for engineering applications.		L4
CO2	Understand	the concept of eigen values, eigen vectors and quadratic forms.			L2
CO3	Analyze	the mean value theorems	for real time applications.		L4
CO4	Apply	the concept of Maxima and Minima	to functions of several variables.		L3
CO5	Apply	the multivariable integral calculus	for computation of Area and volume.		L3

Unit I:

Matrices

Rank of a matrix by Echelon form, Normal form, Cauchy-Binet formula (without proof). Inverse of Non-singular matrices by Gauss-Jordan method, system of linear equations: solving system of Homogeneous and Non-homogeneous equations by Gauss Elimination method, Jacobi and Gauss Seidel Iteration methods.

Unit II
Eigen values, Eigen vectors and Orthogonal Transformation

Eigen values, Eigen vectors and their properties, Diagonalization of a matrix, Cayley-Hamilton theorem (without proof), finding inverse and power of a matrix by Cayley-Hamilton theorem, Quadratic forms and Nature of the Quadratic forms, Reduction of quadratic form to canonical forms by Orthogonal Transformation.

Unit III
Calculus

Mean Value Theorems: Rolle’s theorem, Lagrange’s mean value theorem with their geometrical interpretation, Cauchy’s mean value theorem, Taylor’s and Maclaurin's theorems with remainders (without proof), problems and applications on the above theorems.

Unit IV
Partial differentiation and Applications (Multi Variable Calculus

Functions of several variables: Continuity and Differentiability, Partial derivatives, total derivatives, chain rule, Directional derivative, Taylor’s and Maclaurin's series expansion of functions of two variables, Jacobians, Functional dependence, Maxima and Minima of functions of two variables, method of Lagrange multipliers.

Unit V
Multiple Integrals

Double integrals, triple integrals change of order of integration, change of Variables to polar, Cylindrical and Spherical coordinates, Finding areas (by double integrals) and volumes (by double integrals and triple integrals).

Text Books:

1. B. S. Grewal, Higher Engineering Mathematics, 44/e, Khanna Publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10/e, John Wiley & Sons, 2011.

Reference Books:

1. Thomas Calculus, George B. Thomas, Maurice D. Weir and Joel Hass, Pearson Publishers, 2018, 14th Edition.
2. Advanced Engineering Mathematics, R. K. Jain and S. R. K. Iyengar, Alpha Science International Ltd., 25th Edition (9th reprint).
3. Advanced Modern Engineering Mathematics, Glyn James, Pearson publishers, 2018, 5th Edition.
4. Advanced Engineering Mathematics, Micheael Greenberg, Pearson publishers, 9th edition.
5. Higher Engineering Mathematics, H. K Das, Er. Rajnish Verma, S. Chand Publications, 2014, Third Edition (Reprint 2021).

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Linear Algebra and Calculus	CO1		3											
	CO2		2											
	CO3		3											
	CO4	3												
	CO5	3												

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	10	14	2	Analyze	L4	PO2	Analyze	3
2	15	21.4	3	Understand	L2	PO2	Apply	2
3	15	21.4	3	Analyze	L4	PO2	Analyze	3
4	16	22.8	3	Apply	L3	PO1	Apply	3
5	14	20	3	Apply	L3	PO1	Apply	3
Total	**70**							

Justification Statements:

CO1: Analyze the matrix algebraic techniques that are needed for engineering applications.
Action Verb: Analyze(L4)
PO2 Verbs: Analyze (L4)
CO1 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO2: Understand the concept of eigen values, eigen vectors and quadratic forms.

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO2 Action Verb is low level to PO1 verb by one level; Therefore, correlation is moderate (2).

CO3: Analyze the mean value theorems for real life problems.

Action Verb: Analyze **(L4)**

PO1 Verb: Analyze (L4)

CO3 Action Verb level is equal to PO2 verb; Therefore, correlation is high (3).

CO4: Apply the concept of Maxima and Minima of functions of several variables.

Action Verb: Apply (L3)

PO2 Verb: Apply (L3)

CO4 Action Verb level is equal to PO1 verb; Therefore, correlation is high (3).

CO5: Apply the multivariable integral calculus for computation of area and volume.

Action Verb: Apply(L3)

PO1 Verb: Apply (L3)

CO5 Action verb is high level to PO1 verb; therefore, the correlation is high (3).

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Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AES0201	Basic Electrical & Electronics Engineering	3	0	0	3

Part – A

Course Outcomes:

CO: 1 Understand the fundamental laws of A. C circuits and D. C circuits.
CO: 2 Understand operating principles of motors, generators and measuring instruments.
CO: 3 Understand the fundamentals of power generation, costing and safety measures

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The fundamentals laws of A. C circuits and D. C circuits.		A. C circuits and D. C circuits	L2
CO2	Understand	Operating principles of motors, generators and measuring instruments.			L2
CO3	Understand	The fundamentals of Power generation, costing and safety measures.			L2

Unit I:
DC & AC Circuits

DC Circuits: Electrical circuit elements (R, L and C), Ohm's Law and its limitations, KCL & KVL, series, parallel, series-parallel circuits, Super Position theorem, Simple numerical problems.

AC Circuits: A.C. Fundamentals: Equation of AC Voltage and current, waveform, time period, frequency, amplitude, phase, phase difference, average value, RMS value, form factor, peak factor, Voltage and current relationship with phasor diagrams in R, L, and C circuits, Concept of Impedance, Active power, reactive power and apparent power, Concept of power factor (Simple Numerical problems).

Unit II
Machines and Measuring Instruments

Machines: Construction, principle and operation of (i) DC Motor, (ii) DC Generator, (iii) Single Phase Transformer, (iv) Three Phase Induction Motor and (v) Alternator, Applications of electrical machines.

Measuring Instruments: Construction and working principle of Permanent Magnet Moving Coil (PMMC), Moving Iron (MI) Instruments and Wheat Stone Bridge.

Unit III
Energy Resources, Electricity Bill & Safety Measures

Energy Resources: Conventional and non-conventional energy resources; Layout and operation of various Power Generation systems: Hydel, Nuclear, Solar & Wind power generation.

Electricity bill: Power rating of household appliances including air conditioners, PCs, Laptops, Printers, etc. Definition of "unit" used for consumption of electrical energy, two-part electricity tariff, calculation of electricity bill for domestic consumers.

Equipment Safety Measures: Working principle of Fuse and Miniature circuit breaker (MCB), merits and demerits. Personal safety measures: Electric Shock, Earthing and its types, Safety Precautions to avoid shock.

Text Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition 2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013.
2. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition.

Reference Books:

1. Basic Electrical Engineering, D. P. Kothari and I. J. Nagrath, Mc Graw Hill, 2019, Fourth Edition.
2. Principles of Power Systems, V.K. Mehtha, S. Chand Technical Publishers, 2020.
3. Basic Electrical Engineering, T. K. Nagsarkar and M. S. Sukhija, Oxford University Press, 2017.
4. Basic Electrical and Electronics Engineering, S. K. Bhatacharya, Person Publications, 2018, Second Edition.

Web Resources:

1. https://nptel.ac.in/courses/108105053
2. https://nptel.ac.in/courses/108108076

Part – B

Course Outcomes:

CO: 4 Understand the fundamental concepts of diodes, transistors and its applications.
CO: 5 Analyze the concepts of rectifiers, power supplies and amplifiers in electronics.
CO: 6 Analyze the concepts of Number Systems, Boolean Functions, Logic Gates and Digital Circuits

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	fundamental concepts of diodes, transistors and its applications			L2
CO2	Analyze	concepts of rectifiers, power supplies and amplifiers in electronics			L4
CO3	Analyze	concepts of Number Systems, Boolean Functions, Logic Gates and Digital Circuits			L4

Unit I:
Semiconductor Devices

Introduction - Evolution of electronics – Vacuum tubes to nano electronics - Characteristics of PN Junction Diode — Zener Effect — Zener Diode and its Characteristics. Bipolar Junction Transistor — CB, CE, CC Configurations and Characteristics — Elementary Treatment of Small Signal CE Amplifier.

Unit II
Basic Electronic Circuits and Instrumentation

Rectifiers and power supplies: Block diagram description of a DC power supply, working of a full wave bridge rectifier, capacitor filter (no analysis), working of simple Zener voltage regulator. Amplifiers: Block diagram of Public Address system, Circuit diagram and working of common emitter (RC coupled) amplifier with its frequency response. Electronic Instrumentation: Block diagram of an electronic instrumentation system.

Unit III
Digital Electronics

Overview of Number Systems, Logic gates including Universal Gates, BCD codes, Excess-3 code, Gray code, Hamming code. Boolean Algebra, Basic Theorems and properties of Boolean Algebra, Truth Tables and Functionality of Logic Gates – NOT, OR, AND, NOR, NAND, XOR and XNOR. Simple combinational circuits–Half and Full Adder, Introduction to sequential circuits, Flip flops, Registers and counters (Elementary Treatment only).

Text Books:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009.

Reference Books:

1. R. S. Sedha, A Textbook of Electronic Devices and Circuits, S. Chand & Co, 2010.
2. Santiram Kal, Basic Electronics- Devices, Circuits and IT Fundamentals, Prentice Hall, India, 2002.
3. R. T. Paynter, Introductory Electronic Devices & Circuits – Conventional Flow Version, Pearson Education, 2009.

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Physics	CO1	2	2				1							
	CO2	2	1				1							
	CO3	2	1				2							
	CO4	2	3											
	CO5	3	3											
	CO6	3	3											

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	08	30	3	Understand	L2	PO1, PO2, PO6	PO1: Apply (L3) PO2: Identify (L3) PO6: Thumb Rule	2 2 1
2	08	30	3	Understand	L2	PO1, PO2, PO6	PO1: Apply (L3) PO2: Analyze(L4) PO6: Thumb Rule	2 1 1
3	10	38	3	Understand	L2	PO1, PO2, PO6	PO1: Apply (L3) PO2: Analyze(L4) PO6: Thumb Rule	2 1 2
4	08	30	3	Understand	L2	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	2 3
5	08	30	3	Analyze	L4	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	3 3
6	10	38	3	Analyze	L4	PO1, PO2	PO1: Apply(L3) PO2: Review (L2)	3 3
Total	**52**							

Justification Statements:

CO1: Understand the fundamental laws of AC and DC circuits.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Identify (L3)
CO1 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO6: Using thumb rule, CO1 correlates PO6 as low (1).
CO2: Understand operating principles of motors, generators, MC and MI instruments.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO2 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO2 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1).

PO6: Using thumb rule, CO2 correlates PO6 as low (1).

CO3: Understand the fundamentals of power generation, costing and safety measures.

Action Verb: Understand (L2)

PO1: Apply (L3)

CO3 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2: Analyze (L4)

CO3 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1).

PO6: Using thumb rule, CO3 correlates PO6 as medium (2).

CO4: Understand the fundamental concepts of diodes, transistors and its applications

Action Verb: Understand (L2)

PO1 Verbs: Apply (L3)

CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).

PO2 Verbs: Review (L2)

CO4 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO5: Analyze the concepts of rectifiers, power supplies and amplifiers in electronics.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO5 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).

PO2 Verbs: Review (L2)

CO5 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO6: Analyze the concepts of Number Systems, Boolean Functions, Logic Gates and Digital Circuits.

Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)

CO6 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).

PO2 Verbs: Review (L2)

CO6 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

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Course structure for Four Year Regular B.Tech. Degree Program
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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I/II** **Branch of Study: Common to all Branches**

Subject Code	Subject Name	L	T	P	Credits
23AES0301	Engineering Graphics	1	0	4	3

Course Outcomes:

CO: 1 Apply the concepts of engineering curves and scales for technical drawing.
CO: 2 Understand the quadrant system to locate the position of points, lines and planes.
CO: 3 Analyze the projection of solids located in quadrant system.
CO: 4 Analyze the sectional views and development of surfaces of regular solids.
CO: 5 Apply orthographic and isometric projections concepts to construct the given object

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the concepts of engineering curves and scales		for technical drawing	L3
CO2	Understand	the quadrant system to locate the position of points, lines and planes			L2
CO3	Analyze	the projection of solids		located in quadrant system	L4
CO4	Analyze	the sectional views anddevelopment of surfaces		of regular solids	L4
CO5	Apply	orthographic and isometric projections concepts to constructthe given object			L3

Unit I: Introduction: Lines, Lettering and Dimensioning, Geometrical Constructions and Constructing regular polygons by general methods.

Curves: construction of ellipse, parabola and hyperbola by general, Cycloids, Involutes, Normal and tangent to Curves.

Scales: Plain scales, diagonal scales and vernier scales.

Unit II

Orthographic Projections: Reference plane, importance of reference lines or Plane, Projections of a point situated in any one of the four quadrants.

Projections of Straight Lines: Projections of straight lines parallel to both reference planes, perpendicular to one reference plane and parallel to other reference plane, inclined to one reference plane and parallel to the other reference plane. Projections of Straight Line Inclined to both the reference planes

Projections of Planes: regular planes Perpendicular to both reference planes, parallel to one reference plane and inclined to the other reference plane; plane inclined to both the reference planes.

Unit III

Projections of Solids: Types of solids: Polyhedra and Solids of revolution. Projections of solids in simple positions: Axis perpendicular to horizontal plane, Axis perpendicular to vertical planeand Axis parallel to both the reference planes, Projection of Solids with axis inclined to one reference plane and parallel to another plane.

Unit IV

Sections of Solids: Perpendicular and inclined section planes, Sectional views and True shapeof section, Sections of solids in simple position only.

Development of Surfaces: Methods of Development: Parallel line development and radial linedevelopment. Development of a cube, prism, cylinder, pyramid and cone.

Unit V

Conversion of Views: Conversion of isometric views to orthographic views; Conversion of orthographic views to isometric views. **Computer graphics**: Creating 2D&3D drawings of objects including PCB and Transformationsusing Auto CAD (*Not for end examination*).

Text Books:

1. K. L. Narayana & P. Kannaiah, Engineering Drawing, 3/e, Scitech Publishers
2. N. D. Bhatt, Engineering Drawing, 53/e, Charotar Publishers

Reference Books:

1. Engineering Drawing, K.L. Narayana and P. Kannaiah, Tata McGraw Hill, 2013.
2. Engineering Drawing, M.B. Shah and B.C. Rana, Pearson Education Inc,2009.
3. Engineering Drawing with an Introduction to AutoCAD, Dhananjay Jolhe, TataMcGraw Hill, 2017.

Articulation Matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Graphics	CO1	3		3						3			2	2
	CO2	2		2						3			2	2
	CO3	2		2									2	2
	CO4	3		3		3							2	2
	CO5	3		3		3				3			2	2

4. (Levels of Correlation, viz., 1-Low, 2-Moderate, 3-High)

Correlation Matrix

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	18	24	3	Apply	L3	PO1 PO3 PO9	Apply (L3) Develop (L3) Thumb Rule	3 3 1
2	15	20	2	Understand	L2	PO1 PO3 PO9	Apply (L3) Develop (L3) Thumb Rule	2 2 1
3	15	20	2	Analyze	L4	PO1 PO3 PO9	Apply (L3) Develop (L3) Thumb Rule	3 3 1
4	15	20	2	Analyze	L4	PO1 PO3 PO9	Apply (L3) Develop (L3) Thumb Rule	3 3 1
5	12	16	2	Apply	L3	PO1 PO3 PO9	Apply (L3) Develop (L3) Thumb Rule	3 3 1

Justification Statements:

CO1: Apply the concepts of engineering curves for technical drawing

Action Verb: Apply (L3)

PO1 Verb: **Apply (L3)**

CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO9 Verb: Thumb Rule (TR)

CO1: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO2: Understand the quadrant system to locate the position of points and projection of lines.

Action Verb: Understand (L2)

PO1 Verb: **Apply (L3)**

CO2: Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)

PO3 Verb: **Develop (L3)**

CO2: Action verb is less than PO2 verb by one level. Therefore, the correlation is medium (2)

PO9 Verb: Thumb Rule (TR)

CO2: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO3: Analyze the projection of planes as well as solids located in quadrant system**.**

Action Verb: Analyze (L4)

PO1 Verb: **Apply (L3)**

CO3: Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO3: Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO9 Verb: Thumb Rule (TR)

CO3: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO4: Analyze the sectional views and development of surfaces of regular solids

Action Verb: Analyze (L4)

PO1 Verb: **Apply (L3)**

CO4: Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Develop (L3)**

CO4: Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO9 Verb: Thumb Rule (TR)

CO4: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

CO5: Apply orthographic and isometric projections concepts to construct the given object**.**

Action Verb: Apply (L3)

PO1 Verb: **Apply (L3)**

CO5: Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Develop (L3)**

CO5: Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO9 Verb: Thumb Rule (TR)

CO5: Engineering graphics involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I/II** **Branch of Study: Common to all Branches**

Subject Code	Subject Name	L	T	P	Credits
23AES0501	Introduction To Programming (Common to All branches of Engineering)	3	0	0	3

Course Outcomes:

CO: 1 Understand the computer Programming concepts and Algorithms.
CO: 2 Analyze the control structures to implement basic programs.
CO: 3 Understand the concept of Arrays and string to manipulate the stored data.
CO: 4 Create the dynamic memory allocation using pointers and structures.
CO: 5 Create the user defined functions and files for modifying stored data

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the computer Programming concepts and Algorithms.			L2
CO2	Analyze	the control structures		to implement basic programs.	L4
CO3	Understand	the concept of Arrays and string		to manipulate the stored data	L2
CO4	Create	the dynamic memory allocation	using pointers and structures.		L6
CO5	Create	user defined functions and files		for modifying stored data.	L6

Unit I:

Introduction: History of Computers, Basic organization of a computer: ALU, input-output units, memory, program counter, Introduction to Programming Languages, Basics of a Computer Program- Algorithms, flowcharts (Using Dia Tool), pseudo code. Introduction to Compilation and Execution, Primitive Data Types, Variables, and Constants, Basic Input and Output, Operations, Type Conversion, and Casting.

Problem solving techniques: Algorithmic approach, characteristics of algorithm, Problem solving strategies: Top-down approach, Bottom-up approach, Time and space complexities of algorithms.

Unit II

Control Structures: Simple sequential programs Conditional Statements (if, if-else, switch), Loops (for, while, do- while) Break and Continue.

Unit III

Arrays and Strings: Arrays indexing, memory model, programs with array of integers, two dimensional arrays, Introduction to Strings.

Unit IV

Pointers & User Defined Data types: Pointers, dereferencing and address operators, pointer and address arithmetic, array manipulation using pointers, User-defined data types-Structures and Unions.

Unit V

Functions & File Handling: Introduction to Functions, Function Declaration and Definition, Function call Return Types and Arguments, modifying parameters inside functions using pointers, arrays as parameters. Scope and Lifetime of Variables, Basics of File Handling.

Text Books:

1. "The C Programming Language", Brian W. Kernighan and Dennis M. Ritchie, Prentice- Hall, 1988
2. Schaum's Outline of Programming with C, Byron S Gottfried, McGraw-Hill Education, 1996

Reference Books:

1. Computing fundamentals and C Programming, Balagurusamy, E., McGraw-Hill Education, 2008.
2. Programming in C, Rema Theraja, Oxford, 2016, 2nd edition
3. C Programming, A Problem Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE, 3rd edition.

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Introduction to Programming	CO1	2	3	2									3	
	CO2	3	3	3								2	2	
	CO3	2	3									2	2	
	CO4	3	3	3								2	2	
	CO5	3	3	3								3	2	2

Correlation Matrix

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	19	25%	3	CO1: Understand	L2	PO1 PO2 PO3	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3)	2 3 2
2	10	14%	2	CO2: Analyze	L4	PO1 PO2 PO3 PO11	PO1: Apply(L3) PO2: Analyze (L4) PO3: Develop (L3) PO11: Thumb rule	3 3 3 2
3	19	25%	3	CO3: Understand	L2	PO1 PO2 PO11	PO1: Apply(L3) PO2: Review (L2) PO11: Thumb rule	2 3 2
4	15	20%	2	CO4: Create	L6	PO1 PO2 PO3 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop (L3) PO11: Thumb rule	3 3 3 2
5	12	16%	2	CO5: Create	L6	PO1 PO2 PO3 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO11: Thumb rule	3 3 3 3
	75	100%						

Justification Statements:

CO1: Understand the computer Programming concepts and Algorithms.

Action Verb: Understand (L2)

PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review (L2)
CO1 Action verb is same as than as PO2 verb by two level. Therefore, the correlation is High (3)
PO3 Verb: Develop (L3)
CO1 Action verb is less than as PO2 verb by one level. Therefore, the correlation is moderate (2)

CO2: Analyze the control structures to implement basic programs.

Action Verb: Analyze (L4)

PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Analyze (L4)
CO2 Action verb is equal to PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Some of the flow of control statements knowledge are used to solve various problems. Therefore, the correlation is moderate (2)

CO3: Understand the concept of Arrays and string to manipulate the stored data.

Action Verb: Understand (L2)

PO1: Apply (L3)
CO3 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2: Review (L2)
CO3 Action verb is Same as PO2 verb. Therefore, the correlation is High (3)
PO11: Thumb rule
For some matrix operations array and string concepts were used Therefore, the correlation is moderate (2)

CO4: Create the dynamic memory allocation using pointers and structures.

Action Verb: Create (L6)

PO1: Apply (L3)
CO4 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO2: Review (L2)
CO4 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is greater than PO3 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some mathematical operations Pointers and structures are used to manipulate the memory references. Therefore, the correlation is moderate (2)

CO5: Create the user defined functions and files for modifying stored data.

Action Verb: Create (L6)

PO1: Apply (L3)
CO5 Action verb is greater than PO1 verb by two levels. Therefore, the correlation is high (3)
PO2: Review (L2)
CO5 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO5 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
In today's world file handling techniques were used in most of the areas. Therefore, the correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AES0503	IT Workshop (Common to AIML, AIDS, CE, ECE & ME)	0	0	2	1

Course Outcomes:

CO: 1 Understand The Process of Software Installation & Hardware troubleshooting.
CO: 2 Analyze the network configurations for customizing web pages and search engines.
CO: 3 Apply the basic editing function, formatting text & objects on a required content.
CO: 4 Apply the formulas, functions and visualizations to manage the data.
CO: 5 Understand the libraries and models of chatGPT to generate information

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	The Process of Software Installation & Hardware troubleshooting.			L2
CO2	Analyze	the network configurations		for customizing web pages and search engines	L4
CO3	Apply	The basic editing function, formatting text & objects		on a required content	L3
CO4	Apply	the formulas, functions and visualizations		to manage the data	L3
CO5	Understand	The libraries and models of chatGPT		to generate information	L2

List of Experiments

PC Hardware & Software Installation

Task 1: Identify the peripherals of a computer, components in a CPU and its functions. Draw the block diagram of the CPU along with the configuration of each peripheral and submit to your instructor.[CO1]

Task 2: Every student should disassemble and assemble the PC back to working condition. Lab instructors should verify the work and follow it up with a Viva. Also students need to go through the video which shows the process of assembling a PC. A video would be given as part of the course content.[CO1]

Task 3: Every student should individually install MS windows on the personal computer. Lab instructor should verify the installation and follow it up with a Viva.[CO1]

Task 4: Every student should install Linux on the computer. This computer should have windows installed. The system should be configured as dual boot (VMWare) with both Windows and Linux. Lab instructors should verify the installation and follow it up with a Viva.[CO1]

Task 5: Every student should install BOSS on the computer. The system should be configured as dual boot (VMWare) with both Windows and BOSS. Lab instructors should verify the installation and follow it up with a Viva.[CO1]

Internet & World Wide Web

Task1: Orientation & Connectivity Boot Camp: Students should get connected to their Local Area Network and access the Internet. In the process they configure the TCP/IP setting. Finally students should demonstrate, to the instructor, how to access the websites and email. If there is
no internet connectivity preparations need to be made by the instructors to simulate the WWW on the LAN.[CO2]

Task 2: Web Browsers, Surfing the Web: Students customize their web browsers with the LAN proxy settings, bookmarks, search toolbars and pop up blockers. Also, plug-ins like Macromedia Flash and JRE for applets should be configured.[CO2]

Task 3: Search Engines & Netiquette: Students should know what search engines are and how to use the search engines. A few topics would be given to the students for which they need to search on Google. This should be demonstrated to the instructors by the student. [CO2]

Task 4: Cyber Hygiene: Students would be exposed to the various threats on the internet and would be asked to configure their computer to be safe on the internet. They need to customize their browsers to block pop ups, block active x downloads to avoid viruses and/or worms. [CO2]

LaTeX and WORD

Task 1 – Word Orientation: The mentor needs to give an overview of La TeX and Microsoft (MS) office or equivalent (FOSS) tool word: Importance of La TeX and MS office or equivalent (FOSS) tool Word as word Processors, Details of the four tasks

and features that would be covered in each, Using La TeXand word – Accessing, overview of toolbars, saving files, Using help and resources, rulers, format painter in word. [CO3]

Task 2: Using La TeX and Word to create a project certificate. Features to be covered:- Formatting Fonts in word, Drop Cap in word, Applying Text effects, Using Character Spacing, Borders and Colors, Inserting Header and Footer, Using Date and Time option in both La TeX and Word. [CO3]

Task 3: Creating project abstract Features to be covered:-Formatting Styles, Inserting table, Bullets and Numbering, Changing Text Direction, Cell alignment, Footnote, Hyperlink, Symbols, Spell Check, Track Changes. [CO3]

Task 4: Creating a Newsletter: Features to be covered:- Table of Content, Newspaper columns, Images from files and clipart, Drawing toolbar and Word Art, Formatting Images, Textboxes, Paragraphs and Mail Merge in word. [CO3]

EXCEL

Excel Orientation: The mentor needs to tell the importance of MS office or equivalent (FOSS) tool Excel as a Spreadsheet tool, give the details of the four tasks and features that would be covered in each. Using Excel – Accessing, overview of toolbars, saving excel files, Using help and resources. [CO4]

Task 1: Creating a Scheduler - Features to be covered: Gridlines, Format Cells, Summation, auto fill, Formatting Text[CO4]

Task 2: Calculating GPA -. Features to be covered:- Cell Referencing, Formulae in excel – average, std. deviation, Charts, Renaming and Inserting worksheets, Hyper linking, Count function, [CO4]

LOOKUP/VLOOKUP

Task 3: Split cells, freeze panes, group and outline, Sorting, Boolean and logical operators, Conditional formatting[CO4]

POWER POINT

Task 1: Students will be working on basic power point utilities and tools which help them create basic power point presentations. PPT Orientation, Slide Layouts, Inserting Text, Word Art, Formatting Text, Bullets and Numbering, Auto Shapes, Lines and Arrows in PowerPoint. [CO4]

Task 2: Interactive presentations - Hyperlinks, Inserting –Images, Clip Art, Audio, Video, Objects, Tables and Charts. [CO4]

Task 3: Master Layouts (slide, template, and notes), Types of views (basic, presentation, slide slotter, notes etc), and Inserting – Background, textures, Design Templates, Hidden slides. [CO4]

AI TOOLS – ChatGPT

Task 1: Prompt Engineering: Experiment with different types of prompts to see how the model responds. Try asking questions, starting conversations, or even providing incomplete sentences to see how the model completes them. [CO5]

• Ex: Prompt: "You are a knowledgeable AI. Please answer the following question: What is the capital of France?"

Task 2: Creative Writing: Use the model as a writing assistant. Provide the beginning of a story or a description of a scene, and let the model generate the rest of the content. This can be a fun way to brainstorm creative ideas[CO5]

• Ex: Prompt: "In a world where gravity suddenly stopped working, people started floating upwards. Write a story about how society adapted to this new reality."

Task 3: Language Translation: Experiment with translation tasks by providing a sentence in one language and asking the model to translate it into another language. Compare the output to see how accurate and fluent the translations are. [CO5]

• Ex:Prompt: "Translate the following English sentence to French: 'Hello, how are you doing today?'"

Reference Books:

1. Comdex Information Technology course tool kit, Vikas Gupta, WILEY Dream tech, 2003
2. The Complete Computer upgrade and repair book, Cheryl A Schmidt, WILEY Dream tech, 2013, 3rd edition
3. Introduction to Information Technology, ITL Education Solutions limited, Pearson Education, 2012, 2nd edition
4. PC Hardware - A Handbook, Kate J. Chase, PHI (Microsoft)
5. LaTeX Companion, Leslie Lamport, PHI/Pearson.
6. IT Essentials PC Hardware and Software Companion Guide, David Anfins on and Ken Quamme. – CISCO Press, Pearson Education, 3rd edition
7. IT Essentials PC Hardware and Software Labs and Study Guide, Patrick Regan– CISCO Press, Pearson Education, 3rd edition

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Physics	CO1	2	3										1	
	CO2	3	3	3	3	3								
	CO3	3	3	3	2	3						3	2	
	CO4	3	3	3	2	3						3		2
	CO5	2	2											1

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)

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1	CO1: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Review(L2)	2 3
2	CO2: Analyze	L4	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Identify (L3) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3)	3 3 3 3 3
3	CO3: Apply	L3	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb rule	3 3 3 2 3 3
4	CO4: Apply	L3	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO4: Analyze (L4) PO5: Apply (L3) PO11: Thumb rule	3 3 3 2 3 3
5	CO5: Understand	L2	PO1 PO2	PO1: Apply(L3) PO2: Identify (L3)	2 2

Justification Statements :

CO1: Understand The Process of Software Installation & Hardware troubleshooting
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review(L2)
CO1 Action verb is same as PO2 verb. Therefore, the correlation is high (3)

CO2: Analyze the network configurations for customizing web pages and search engines
Action Verb: Analyze (L4)
PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Identify(L3)
CO2 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO2 Action verb is greater than as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply (L3)
CO2 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)

CO 3: Apply The basic editing function, formatting text & objects on a required content.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review(L2)
CO3 Action verb is less than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop(L3)
CO3 Action verb is same as PO3 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is less than as PO4 verb. Therefore, the correlation is moderate (2)
PO5: Apply (L3)
CO3 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Documentation and presentation is learning process to find the solution better manner the correlation is high (3)

CO 4: Apply the formulas, functions and visualizations to manage the data.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO4 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: idetify(L3)
CO4 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)
PO3: Develop (L3)
CO4 Action verb is same as PO3 verb. Therefore, the correlation is high (3)

PO4: Analyze (L4)
CO4 Action verb is less than as PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply (L3)
CO4 Action verb is greater than as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
Spread sheets in Excel is the trending approach in the current days Therefore, the correlation is high (3)

CO 5: Understand the libraries and models of chatGPT to generate information.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Identify(L3)
CO1 Action verb is same as PO2 verb. Therefore, the correlation is moderate (2)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23ABS9908	Engineering Physics Lab	0	0	2	1

Course Outcomes:

CO: 1 Analyze the properties of light for engineering problems.
CO: 2 Evaluate the crystallite size using X-ray diffraction.
CO: 3 Analyze the basic properties of dielectric and magnetic behavior of the given material.
CO: 4 Determine the mechanical behavior of a given material.
CO: 5 Evaluate the basic parameters of a given semiconductor material

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	The properties of light		for engineering problems.	L4
CO2	Evaluate	The crystallite size using X-ray diffraction.			L5
CO3	Analyze	The basic properties of dielectric and magnetic behavior of the given material.			L4
CO4	Determine	The mechanical behavior of a given material.			L5
CO5	Evaluate	The basic parameters of a given semiconductor material.			L5

List of Experiments:

1. Determination of radius of curvature of a given Plano-convex lens by Newton's rings – CO1.
2. Determination of wavelengths of different spectral lines in mercury spectrum using diffraction grating in normal incidence configuration – CO1.
3. Study the variation of B versus H by magnetizing the magnetic material (B-H curve) – CO3.
4. Determination of wavelength of Laser light using diffraction grating – CO1.
5. Magnetic field along the axis of a current carrying circular coil by Stewart Gee's Method – CO3.
6. Determination of energy gap of a semiconductor using p-n junction diode – CO5.
7. Determination of the resistivity of semiconductors by four probe methods – CO5.
8. Determination of the crystallite size using X-Ray Diffraction spectra – CO2.
9. Determination of the numerical aperture of a given optical fiber and angle of acceptance – CO1.
10. Verification of Brewster's law – CO1.
11. Determination of acceleration due to gravity and radius of Gyration by using a compound pendulum – CO4.
12. Determination of rigidity modulus of the material of the given wire using Torsional pendulum – CO4.
13. Determination of temperature coefficients of a thermistor – CO5.
14. Determination of dielectric constant using charging and discharging method – CO3.
15. Determination of Hall voltage and Hall coefficient of a given semiconductor using Hall Effect – CO5.
16. Sonometer: Verification of laws of stretched string – CO4.
17. Determination of magnetic susceptibility by Kundt's tube method – CO3.
18. Determination of Frequency of electrically maintained tuning fork by Melde's experiment – CO4.

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO

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Experiments may be conducted in virtual mode.

References: A Textbook of Practical Physics - S. Balasubramanian, M. N. Srinivasan, S. Chand Publishers, 2017.

URL: www.vlab.co.in

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Engineering Physics Lab	CO1	1	3			3								
	CO2	2	3			3								
	CO3	3	3			3								
	CO4	4	3			3								
	CO5	5	3			3								

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	**9**	**25**	**3**	**Analyze**	**L4**	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
2	**6**	**16**	**2**	**Evaluate**	**L5**	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
3	**9**	**25**	**3**	**Analyze**	**L4**	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
4	**6**	**16**	**2**	**Determine**	**L5**	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
5	**6**	**16**	**2**	**Evaluate**	**L5**	PO1, PO4	PO1: Apply (L3), PO4: Analyze (L4)	3 3
Total	**36**							

Justification Statements:

CO1: Analyze the properties of light for solving engineering problems.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)

CO1 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
CO1 Action Verb is equal to PO4 verb; Therefore, correlation is high (3).

CO2: Evaluate the crystallite size using X-ray diffraction.
Action Verb: Evaluate (L5)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)

CO2 Action Verb is greater than PO1 verb by two levels; Therefore correlation is high (3).
CO2 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).

CO3: Analyze the basic properties of dielectric and magnetic behavior of the given material.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)

CO3 Action Verb level is greater than PO1 action verb by one level; Therefore correlation is high (3).
CO3 Action Verb level is equal to PO4 action verb; Therefore correlation is high (3).

CO4: Determine the mechanical behavior of a given material using dynamic methods.
Action Verb: Determine (L5)
PO1 Verbs: Apply (L3)
PO4 Verb: Analyze (L4)

CO4 Action Verb is greater than PO1 verb by two levels; Therefore correlation is high (3).
CO4 Action Verb is greater than PO4 verb by one level; Therefore correlation is high (3).

CO5: Evaluate the basic parameters of a given semiconductor material.

Action Verb: Evaluate (L5)

PO1 and PO4 Verb: Apply (L3)

CO5 Action Verb is greater than PO1 verb by two levels; Therefore correlation is high (3).
CO5 Action Verb is greater than PO1 verb by one level; Therefore correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AES0202	Electrical & Electronics Engineering Workshop	0	0	3	1.5

Course Outcomes:

CO: 1 Understand the Electrical circuit design, measurement of resistance, power, and power factor.
CO: 2 Apply suitable methods to measure Resistance, power, energy and power factor.
CO: 3 Design suitable methods for magnetization characteristics of D. C shunt generator

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	Electrical circuit design; measurement of resistance, power, power factor			L2
CO2	Apply	Suitable methods to measure Resistance, power, energy and power factor.			L3
CO3	Design	Suitable methods for magnetization characteristics of D. C shunt generator.			L6

PART A
ELECTRICAL ENGINEERING LAB

List of experiments:

1. Verification of Kirchhoff's current law and Voltage law-(CO1).
2. Verification of Superposition theorem-(CO1).
3. Measurement of Resistance using Wheat stone bridge-(CO1).
4. Measurement of Power and Power factor using Single-phase watt-meter-(CO2).
5. Measurement of Earth Resistance using Megger-(CO2).
6. Calculation of Electrical Energy for Domestic Premises-(CO2).
7. Magnetization Characteristics of DC shunt Generator-(CO3).

Reference Books:

1. Basic Electrical Engineering, D. C. Kulshreshtha, Tata McGraw Hill, 2019, First Edition
2. Power System Engineering, P.V. Gupta, M.L. Soni, U.S. Bhatnagar and A. Chakrabarti, Dhanpat Rai & Co, 2013
3. Fundamentals of Electrical Engineering, Rajendra Prasad, PHI publishers, 2014, Third Edition

Note: Minimum Six Experiments to be performed.

PART B
ELECTRONICS ENGINEERING LAB

COURSE OUTCOMES:

CO: 1 Understand the V-I Characteristics of diodes and its applications.
CO: 2 Analyze the input and output characteristics of BJT and its applications.
CO: 3 Analyze the truth tables of all logic gates and f/f's using IC's

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	V-I Characteristics of diodes and its applications.			L2
CO2	Analyze	input and output characteristics of BJT and its applications			L4
CO3	Analyze	Truth tables of all logic gates and f/f's using IC's.			L4

List of Experiments:

1. Plot V-I characteristics of PN Junction diode A) Forward bias B) Reverse bias. (CO4)
2. Plot VI characteristics of Zener Diode and its application as voltage Regulator. (CO4)
3. Implementation of half wave and full wave rectifiers (CO4)
4. Plot Input & Output characteristics of BJT in CE and CB configurations (CO5)
5. Frequency response of CE amplifier. (CO5)
6. Simulation of RC coupled amplifier with the design supplied. (CO5)
7. Verification of Truth Table of AND, OR, NOT, NAND, NOR, Ex-OR, Ex-NOR gates using ICs. (CO6)
8. Verification of Truth Tables of S-R, J-K& D flip flops using respective ICs. (CO6)

Tools Equipment Required: DC Power supplies, Multi meters, DC Ammeters, DC Voltmeters, AC Voltmeters, CROS, and all the required active devices.

References:

1. R. L. Boylestad & Louis Nashlesky, Electronic Devices & Circuit Theory, Pearson Education, 2021.
2. R. P. Jain, Modern Digital Electronics, 4th Edition, Tata Mc Graw Hill, 2009
3. R. T. Paynter, Introductory Electronic Devices & Circuits - Conventional Flow Version, Pearson Education, 2009.

Note: Minimum Six Experiments to be performed. All the experiments shall be implemented using both Hardware and Software

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Electrical & Electronics Engineering Workshop	CO1	2	1		1					1			2	
	CO2	3	2		2					1			2	
	CO3		3		3					1			2	1
	CO4	2	3											
	CO5	3	3											
	CO6	3	3											

Correlation matrix

CO	CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Verb	BTL			
1	Understand	L2	PO1, PO2, PO4, PO9	PO1: Apply (L3) PO2: Analyze (L4) PO4: Analyze (L4) PO9: Thumb Rule	2 1 1 1
2	Apply	L3	PO1, PO2, PO4, PO9	PO1: Apply (L3) PO2: Analyze(L4) PO4: Analyze(L4) PO9: Thumb Rule	3 2 2 1
3	Design	L6	PO2, PO4, PO9	PO2: Analyze(L4) PO4: Design (L6) PO9: Thumb Rule	3 3 1
4	Understand	L2	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	2 3
5	Analyze	L4	PO1, PO2	PO1: Apply (L3) PO2: Review (L2)	3 3
6	Analyze	L4	PO1, PO2	PO1: Apply(L3) PO2: Review (L2)	3 3

Justification Statements:

CO1: Understand the Electrical circuit design, measurement of resistance, power, and power factor.
Action Verb: Understand (L2)
PO1: Apply (L3)
CO1 Action Verb is Less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO2: Analyze (L4)
CO1 Action Verb is Less than PO2 verb by two level; Therefore, correlation is low (1).
PO4: Analyze (L4)
CO1 Action Verb is Less than PO4 verb by two level; Therefore, correlation is low (1).
PO9: Using Thumb Rule, CO1 correlates to PO9 as low (1).

CO2: Apply suitable methods to measure Resistance, power, energy and power factor.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO2 Action Verb is same as PO1 verb; Therefore, correlation is high (3).
PO2: Analyze (L4)
CO2 Action Verb is Less than PO2 verb by one level; Therefore, correlation is moderate (2).
PO4: Analyze (L4)
CO2 Action Verb is Less than PO4 verb by one level; Therefore, correlation is moderate (2).
PO9: Using Thumb Rule, CO2 correlates to PO9 as low (1).

CO3: Design suitable methods for magnetization characteristics of D. C shunt generator.
Action Verb: Design (L6)
PO2: Analyze (L4)
CO3 Action Verb is greater than PO2 verb by two level; Therefore, correlation is high (3).
PO4: Design (L6)
CO3 Action Verb is same as PO4 verb; Therefore, correlation is high (3).
PO9: Using Thumb Rule, CO3 correlates to PO9 as low (1).

CO4: Understand the V-I Characteristics of diodes and its applications.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2)
PO2 Verbs: Review (L2)
CO4 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO5: Analyze the input and output characteristics of BJT and its applications.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO5 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2 Verbs: Review (L2)
CO5 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

CO6: Analyze the truth tables of all logic gates and f/f's using IC's.
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO6 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2 Verbs: Review (L2)
CO6 Action Verb is equal to PO2 verb; Therefore, correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AES0502	Computer Programming Lab	0	0	3	1.5

Course Outcomes:

CO: 1 Understand the basic syntax of C program to build applications.
CO: 2 Create the control structure for solving complex problems.
CO: 3 Apply the concepts of arrays, functions, basic concepts of pointers to organize the data.
CO: 4 Apply the concepts of structures, unions and linked list to manage heterogeneous data.
CO: 5 Create the file applications for storing and accessing data

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	the basic syntax of C program		to build applications	L2
CO2	**Create**	the control structure		for solving complex problems	L6
CO3	**Apply**	the concepts of arrays, functions, basic concepts of pointers		to organize the data	L3
CO4	**Apply**	the concepts of structures, unions and linked list		to manage heterogeneous data	L3
CO5	**Create**	the file applications		for storing and accessing data	L6

List of Experiments:

Exercise 1: Problem-solving using Computers [CO1]
i) Basic Linux environment and its editors like Vi, Vim & Emacs etc.
ii) Exposure to Turbo C, gcc
iii) Writing simple programs using printf(), scanf()

Exercise 2: Problem-solving using Algorithms and Flow charts. [CO1]
i) Sum and average of 3 numbers
ii) Conversion of Fahrenheit to Celsius and vice versa
iii) Simple interest calculation

Exercise 3: Variable types and type conversions [CO2]
i) Finding the square root of a given number
ii) Finding compound interest
iii) Area of a triangle using heron's formulae
iv) Distance travelled by an object

Exercise 4: Operators and the precedence and as associativity [CO2]
i) Evaluate the following expressions.
a. A+B*C+(D*E) + F*G
b. A/B*C-B+A*D/3
c. A+++B---A
d. J= (i++) + (++i)
ii) Find the maximum of three numbers using conditional operator
iii) Take marks of 5 subjects in integers, and find the total, average in float
list and perform insertion, deletion, and traversal.

Exercise 5: Branching and logical expressions [CO2]
i) Write a C program to find the max and min of four numbers using if-else.
ii) Write a C program to generate electricity bill.
iii) Find the roots of the quadratic equation.

iv) Write a C program to simulate a calculator using switch case.
v) Write a C program to find the given year is a leap year or not.

Exercise 6: Loops, while and for loops [CO2]
i) Find the factorial of given number using any loop.
ii) Find the given number is a prime or not.
iii) Compute sine and cos series
iv) Checking a number palindrome
v) Construct a pyramid of numbers.

Exercise 7: 1 D Arrays: searching [CO3]
i) Find the min and max of a 1-D integer array.
ii) Perform linear search on1D array.
iii) The reverse of a 1D integer array
iv) Find 2's complement of the given binary number.
v) Eliminate duplicate elements in an array.

Exercise 8: 2 D arrays, sorting and Strings [CO3]
i) Addition of two matrices
ii) Multiplication two matrices
iii) Sort array elements using bubble sort
iv) Concatenate two strings without built-in functions
v) Reverse a string using built-in and without built-in string functions

Exercise 9: Pointers, structures and dynamic memory allocation [CO3]
i) Write a C program to find the sum of a 1D array using malloc()
ii) Write a C program to find the total, average of n students using structures
iii) Enter n students data using calloc() and display failed students list
iv) Read student name and marks from the command line and display the student details along with the total.
v) Write a C program to implement realloc()

Exercise 10: Bitfields, Self-Referential Structures, Linked lists [CO4]
i) Create and display a singly linked list using self-referential structure.
ii) Demonstrate the differences between structures and unions using a C program.
iii) Write a C program to shift/rotate using bitfields.
iv) Write a C program to copy one structure variable to another structure of the same type.

Exercise 11: Functions, call by value, scope and extent [CO2]
i) Write a C function to calculate NCR value.
ii) Write a C function to find the length of a string.
iii) Write a C function to transpose of a matrix.
iv) Write a C function to demonstrate numerical integration of differential equations using Euler's method

Exercise 12: Recursion, the structure of recursive calls [CO4]
i) Write a recursive function to generate Fibonacci series.
ii) Write a recursive function to find the lcm of two numbers.
iii) Write a recursive function to find the factorial of a number.
iv) Write a C Program to implement Ackermann function using recursion.
v) Write a recursive function to find the sum of series.

Exercise 13: Call by reference, dangling pointers [CO4]
i) Write a C program to swap two numbers using call by reference.
ii) Demonstrate Dangling pointer problem using a C program.
iii) Write a C program to copy one string into another using pointer.
v) Write a C program to find no of lowercase, uppercase, digits and other characters using pointers.

Exercise 14: File handling [CO5]
i) Write a C program to write and read text into a file.
ii) Write a C program to write and read text into a binary file using fread() and fwrite()
iii) Copy the contents of one file to another file.
iv) Write a C program to merge two files into the third file using command-line arguments.
v) Find no. of lines, words and characters in a file
vi) Write a C program to print last n characters of a given file.

Textbooks:
1. 1. Ajay Mittal, Programming in C: A practical approach, Pearson.

2. Byron Gottfried, Schaum' s Outline of Programming with C, McGraw Hill

Reference Books:

1. 1 Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice- Hall of India
2. C Programming, A Problem-Solving Approach, Forouzan, Gilberg, Prasad, CENGAGE

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2	2								2	
CO2	3	3		3							2	2	
CO3	3	3		2	3						3	2	
CO4	3	3	3	2							2	2	
CO5	3	3	3	3							3	2	

Correlation matrix

Unit No.	Co's Action verb	BTL	Program Outcome (PO)	PO(s) : Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
1	CO1: understand	L2	PO1 PO2 PO3 PO4	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze(L4)	2 3 2 2
2	CO2: Create	L6	PO1 PO2 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review (L3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb rule	3 3 3 3 2
3	CO3: Apply	L3	PO1 PO2 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review (L3) PO4: Analyze (L4) PO5: Apply(L3) PO11: Thumb rule	3 3 2 3 3
4	CO4: Apply	L3	PO1 PO2 PO3 PO4 PO11	PO1: Apply(L3) PO2: Review (L2) PO3: Develop(L3) PO4: Analyze (L4) PO11: Thumb rule	3 3 3 2 2
5	CO5: Create	L6	PO1 PO2 PO3 PO4 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop(L3) PO4: Analyze (L4) PO11: Thumb rule	3 3 3 3 3

Justification Statements :

CO1: Understand the basic syntax of C program to build applications.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate (2)
PO2 Verb: Review(L2)
CO1 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)
PO3: Develop(L3)
CO1 Action verb is less than PO3 verb by one level. Therefore, the correlation is moderate (2)
PO4: Analyze(L4)
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is moderate is (2)

CO2: Create the control structure for solving complex problems.
Action Verb: Create (L6)

PO1: Apply (L3)
CO2 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO2 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO2 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply(L3)
CO2 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (2)

CO3: Apply the concepts of arrays, functions, basic concepts of pointers to organize the data..
Action Verb: Apply (L3)
PO1: Apply (L3)
CO3 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO3 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO3 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply(L3)
CO3 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (3)

CO4: Apply the concepts of structures, unions and linked list to manage heterogeneous data.
Action Verb: Apply (L3)
PO1: Apply (L3)
CO4 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO4 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO4 Action verb is less than PO4 verb by one level. Therefore, the correlation is moderate (2)
PO5: Apply(L3)
CO4 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (2)

CO5: Create the file applications for storing and accessing data.
Action Verb: Create (L6)
PO1: Apply (L3)
CO5 Action verb is greater than as PO1 verb. Therefore, the correlation is high (3)
PO2: Review (L3)
CO5 Action verb is same level PO2 verb. Therefore, the correlation is high (3)
PO4: Analyze (L4)
CO5 Action verb is same as PO4 verb. Therefore, the correlation is high (3)
PO5: Apply(L3)
CO5 Action verb is same as PO5 verb. Therefore, the correlation is high (3)
PO11: Thumb rule
For some of Linear Data Structure applications, Linked lists concepts are used to write programs store the data. Therefore, the correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AHM9904	NSS/NCC/Scouts & Guides/ Community Service	0	0	1	0.5

Course Outcomes:

CO: 1 Understand the importance of discipline, character and service motto of community.
CO: 2 Analyze the activities need to be done for nature protection
CO: 3 Analyze the social issues in a community and address it through the base camps

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the importance of discipline, character and service motto		of community	L1
CO2	Analyze	the activities need to be done for nature protection			L4
CO3	Analyze	the social issues in a community and address it through the base camps			L4

UNIT-I

Orientation

General Orientation on NSS/NCC/ Scouts & Guides/Community Service activities, career guidance.

Activities:

i. Conducting –ice breaking sessions-expectations from the course-knowing personal talents and skills.
ii. Conducting orientations programs for the students –future plans-activities-releasing road map etc.
iii. Displaying success stories-motivational biopics- award winning movies on societal issues etc.
iv. Conducting talent show in singing patriotic songs-paintings- any other contribution.

UNIT-II

Nature & Care

Activities:

i. Best out of waste competition.
ii. Poster and signs making competition to spread environmental awareness.
iii. Recycling and environmental pollution article writing competition.
iv. Organizing Zero-waste day.
v. Digital Environmental awareness activity via various social media platforms.

vi. Virtual demonstration of different eco-friendly approaches for sustainable living.
vii. Write a summary on any book related to environmental issues**.**

UNIT-III

Community Service
Activities:

i. Conducting One Day Special Camp in a village contacting village-area leaders- Survey in the village, identification of problems- helping them to solve via media- authorities- experts-etc.
ii. Mental health, Spiritual Health, HIV/AIDS,
iii. Conducting consumer Awareness. Explaining various legal provisions etc.
iv. Women Empowerment Programmes- Sexual Abuse, Adolescent Health and Population Education.
v. Any other programmes in collaboration with local charities, NGOs etc.
vi. Conducting awareness programs on Health-related issues such as General Health.

CORRELATION OF COS WITH THE POS & PSOS:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	2								2				2
CO2	3	3								3				2
CO3	3	3								3				2

CO-POMAPPING JUSTIFICATION:

Unit No	Course Outcomes		Program Outcome (PO)	PO(s):Action Verb and BTL(forPO1 to PO12)	Level of Correlation (0-3)
	CO's Action Verb	BTL			
1	Understand	L2	PO1 PO2 PO10	Apply(L3) Analyze(L4) Thumb Rule	2 3 3
2	Analyze	L4	PO1 PO2 PO10	Apply(L3) Analyze(L4) Thumb Rule	2 3 3
3	Analyze	L4	PO1 PO2 PO10	Apply(L3) Analyze(L4) Thumb Rule	2 3 3

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AHM9901	Communicative English	2	0	0	2

Course Outcomes:

CO: 1 Understand reading / listening texts and to write summaries based on global comprehension of these texts**. (Listening & Reading)**
CO: 2 Apply grammatical structures to formulate sentences and correct word forms**. (Grammar)**
CO: 3 Analyze discourse markers to speak clearly on a specific topic in formal and informal conversations. (**Speaking)**
CO: 4 Analyze a coherent paragraph interpreting graphic elements, figure/graph/chart/table **(Read & Write)**
CO: 5 Create a coherent essay, letter writing, report writing and design a resume**. (Writing)**

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	reading / listening texts and to write summaries based on global comprehension of these texts.			L2
2	Apply	grammatical structures to formulate sentences and correct word forms			L3
3	Analyze	Analyze discourse markers to speak clearly on a specific topic in formal and informal conversations...			L4
4	Analyze	coherent paragraph interpreting a graphic elements.			L4
5	Create	coherent essay, letter writing, report writing and design a resume			L6

UNIT I

Lesson: HUMAN VALUES: Gift of Magi **(Short Story)**

Listening: Identifying the topic, the context and specific pieces of information by listening to short audio texts and answering a series of questions.
Speaking: Asking and answering general questions on familiar topics such as home, family, work, studies and interests; introducing oneself and others.
Reading: Skimming to get the main idea of a text; scanning to look for specific pieces of information.
Writing: Mechanics of Writing-Capitalization, Spellings, Punctuation-Parts of Sentences.
Grammar: Parts of Speech, Basic Sentence Structures-forming questions
Vocabulary: Synonyms, Antonyms, Affixes (Prefixes/Suffixes), Root words.

UNIT II

Lesson: NATURE: The Brook by Alfred Tennyson (Poem)

Listening: Answering a series of questions about main ideas and supporting ideas after listening to audio texts.
Speaking: Discussion in pairs/small groups on specific topics followed by short structure talks.

Reading: Identifying sequence of ideas; recognizing verbal techniques that help to link the ideas in a paragraph together.

Writing: Structure of a paragraph - Paragraph writing (specific topics) **Grammar:** Cohesive devices - linkers, use of articles and zero article; prepositions.

Vocabulary: Homonyms, Homophones, Homographs.

UNIT III

Lesson: BIOGRAPHY: Elon Musk

Listening: Listening for global comprehension and summarizing what is listened to.

Speaking: Discussing specific topics in pairs or small groups and reporting what is discussed

Reading: Reading a text in detail by making basic inferences - recognizing and interpreting specific context clues; strategies to use text clues for comprehension.

Writing: Summarizing, Note-making, paraphrasing

Grammar: Verbs - tenses; subject-verb agreement**.**

Vocabulary: Compound words, Collocations

UNIT IV

Lesson: INSPIRATION: The Toys of Peace by Saki

Listening: Making predictions while listening to conversations/ transactional dialogues without video; listening with video.

Speaking: Role plays for practice of conversational English in academic contexts (formal and informal) - asking for and giving information/directions.

Reading: Studying the use of graphic elements in texts to convey information, reveal trends/patterns/relationships, communicate processes or display complicated data.

Writing: Letter Writing: Official Letters, Resumes, Cover letters

Grammar: Reporting verbs, Direct & Indirect speech, Active & Passive Voice

Vocabulary: Words often confused, Jargons

UNIT V

Lesson: MOTIVATION: The Power of Intrapersonal Communication (An Essay)

Listening: Identifying key terms, understanding concepts and answering a series of relevant questions that test comprehension.

Speaking: Formal oral presentations on topics from academic contexts

Reading: Reading comprehension.

Writing: Writing structured essays on specific topics.

Grammar: Editing short texts –identifying and correcting common errors in grammar and usage (articles, prepositions, tenses, subject verb agreement)

Vocabulary: Idiom and phrases & Phrasal verbs

Textbooks:

1. Pathfinder: Communicative English for Undergraduate Students, 1st Edition, Orient Black Swan, 2023 (Units 1,2 & 3)
2. Empowering with Language by Cengage Publications, 2023 (Units 4 & 5)

Reference Books:

1. Dubey, Sham Ji& Co. English for Engineers, Vikas Publishers, 2020
2. Bailey, Stephen. Academic writing: A Handbook for International Students. Routledge, 2014.
3. Murphy, Raymond. English Grammar in Use, Fourth Edition, Cambridge University Press, 2019.
4. Lewis, Norman. Word Power Made Easy- The Complete Handbook for Building a Superior Vocabulary. Anchor, 2014.

Web Resources:

GRAMMAR:

1. www.bbc.co.uk/learningenglish
2. https://dictionary.cambridge.org/grammar/british-grammar/
3. www.eslpod.com/index.html
4. https://www.learngrammar.net/
5. https://english4today.com/english-grammar-online-with-quizzes/
6. https://www.talkenglish.com/grammar/grammar.aspx

VOCABULARY

1. https://www.youtube.com/c/DailyVideoVocabulary/videos
2. https://www.youtube.com/channel/UC4cmBAit8i_NJZE8qK8sfpA

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23ABS9902	Engineering Chemistry	3	0	0	3

Course Outcomes:

CO: 1 Understand the purification techniques to remove hardness of water
CO: 2 Apply the electrochemical principles to the energy storage devices and corrosion prevention techniques
CO: 3 Analyze the preparation of polymers, elastomers and fuels
CO: 4 Analyse the properties of lubricants, Refractories, composites and cement.
CO: 5 Analyze the properties of colloids and nano materials

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Purification techniques		to remove hardness of water	L2
2	Apply	electrochemical principles to the energy storage devices and corrosion prevention techniques			L3
3	Analyze	preparation of polymers, elastomers and fuels			L4
4	Analyze	properties of lubricants, Refractories, composites and cement			L4
5	Analyze	Properties of colloids and nano materials			L4

UNIT I Water Technology

Soft and hardwater, Estimation of hardness of water by EDTA Method, Estimation of dissolvedOxygen - Boiler troubles –Priming, foaming**,** scale and sludge, Caustic embrittlement, Industrial water treatment – Specifications for drinking water, Bureau of Indian Standards(BIS)and World health organization(WHO) standards, Ion-exchange processes - desalination of brackish water, reverse osmosis (RO) and electrodialysis.

UNIT II Electrochemistry and Applications

Electrodes –electrochemical cell, Nernst equation, cell potential calculations.Primary cells – Zinc-air battery, Secondary cells – Nickel-Cadmium (NiCad),and lithium ion batteries- working principle of the batteries including cell reactions; Fuel cells-Basic Concepts,the principle and working of hydrogen-oxygen Fuel cell.

Corrosion: Introduction to corrosion, electrochemical theory of corrosion, differential aerationcell corrosion, galvanic corrosion, metal oxide formation by dry corrosion, Pilling Bedworth ratios and uses, Factors affecting the corrosion**,** cathodic and anodic protection, electroplating and electro less plating (Nickel and Copper).

UNIT III Polymers and Fuel Chemistry

Introduction to polymers, functionality of monomers, Mechanism of chain growth, step growth polymerization.Thermoplastics and Thermo-setting plastics-: Preparation, properties and applications of polystyrene. PVC Nylon 6,6 and Bakelite.

Elastomers – Preparation, properties and applications of Buna S, Buna N, Thiokol rubbers. **Fuels –** Types of fuels, calorific value of fuels, numerical problems based on calorific value; Analysis of coal (Proximate and Ultimate analysis), Liquid Fuels, refining of petroleum, Octaneand Cetane number- alternative fuels-propane, methanol, ethanol and bio fuel-bio diesel.

UNIT IV Modern Engineering Materials

Composites- Definition, Constituents, Classification- Particle, Fibre and Structural reinforced composites, properties and Engineering applications.

Refractories- Classification, Properties, Factors affecting the refractory materials and Applications.

Lubricants- Classification, Functions of lubricants, Mechanism, Properties of lubricating oils –Viscosity, Viscosity Index, Flash point, Fire point, Cloud point, saponification and Applications.

Building materials- Portland Cement, constituents, Setting and Hardening of cement.

UNIT V Surface Chemistry and Nanomaterials

Introduction to surface chemistry, colloids, nanometals and nanometal oxides, micelle formation, synthesis of colloids (Braggs Method), chemical and biological methods of preparation of nanometals and metal oxides, stabilization of colloids and nanomaterials by stabilizing agents, adsorption isotherm (Freundlich and Longmuir), BET equation (no derivation) applications of colloids and nanomaterials – catalysis, medicine, sensors, etc.

Textbooks:

1. Jain and Jain, Engineering Chemistry, 16/e, DhanpatRai, 2013.
2. Peter Atkins, Julio de Paula and James Keeler, Atkins' Physical Chemistry, 10/e, Oxford University Press, 2010.

Reference Books:

1. H.F.W. Taylor, Cement Chemistry, 2/e, Thomas Telford Publications, 1997.
2. D.J.Shaw, Introduction to Colloids and Surface Chemistry, Butterworth-Heineman, 1992.

Textbook of Polymer Science, Fred W. Billmayer Jr, 3rd Edition.

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1	2												
2	3												
3		3											
4		3											
5		3											

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours				CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Register (Hrs)	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1	10	12	18.4	3	Understand	L2	PO1	PO1: Apply (L3)	2
2	10	22	33.8	3	Apply	L3	PO1	PO1: Apply (L3)	3
3	10	12	18.4	3	Analyze	L4	PO2	PO2: Analyze (L4)	3
4	10	6	9.2	1	Analyze	L4	PO1	PO1: Analyze (L4)	3
5	10	13	20	3	Analyze	L4	PO2	PO2: Analyze (L4)	3

CO1: Understand the purification techniques to remove hardness of water
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO1 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate (2).

CO2: Apply the electrochemical principles to the energy storage devices and corrosion prevention techniques
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO3: Analyze the preparation of polymers and fuels
Action Verb: Analyze (L4)
PO2 Verb: Analyze (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO4: Analyse the properties of lubricants, Refractories, composites and cement.
Action Verb: Analyze (L4)
PO2 Verb: Analyze (L4)
CO4 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO5: Analyze the Properties of colloids and nano materials
Action Verb: Analyze (L4)
PO1 Verb: Analyze (L4)
CO5 Action verb is equal to PO2 verb; therefore the correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23ABS9905	Differential Equations and Vector Calculus	3	0	0	3

Course Outcomes:

CO: 1 Apply the concepts of ordinary differential equations of first order and first degree.
CO: 2 Apply the methods of linear differential equations related to various engineering problems.
CO: 3 Analyze the solutions of partial differential equations using Lagrange's method.
CO: 4 Understand the different operators and identities in the vector calculus.
CO: 5 Evaluate the surface integral and volume integral in the vector calculus using various theorems

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Apply**	The concepts of ordinary differential equations.		of first order and first degree	**L3**
2	**Apply**	The methods of linear differential equations related to various engineering problems.			**L3**
3	**Analyze**	The solutions of partial differential equations.	Using Lagrange's method		**L4**
4	**Understand**	different operators and identities in the vector calculus.			**L2**
5	**Evaluate**	the surface integral and volume integral in the vector calculus.	Using various theorems		**L5**

UNIT I: Linear Differential Equations of first Order and first Degree 9hrs

Linear differential equations-Bernoulli's equations-Exat equations and equations reducible to exact form. Applications: Newton's Law of cooling-Law of natural growth and decay-Electrical circuits.

UNIT II: Equations Reducible to Linear Differential Equations and Applications 9 hrs

Definitions, homogeneous and non-homogeneous , complimentary function, general solution, particular integral, Wronskian, Method of variation of parameters. Simultaneous linear equations, Applications to L-C-R Circuit problems and simple Harmonic motion.

UNIT III: Partial Differential Equations 9 hrs

Introduction and formation of partial differential Equations by elimination of arbitrary constants and arbitrary functions, solutions of first order linear equations using Lagrange's method. Homogeneous Linear Partial differential equations with constant coefficients.

UNIT IV: Vector differentiation 9 hrs

Scalar and vector point functions, vector operator del, del applies to scalar point functions-Gradient, Directional derivative, del applied to vector point functions-Divergence and Curl, vector identities.

UNIT V: Vector integration 9 hrs

Line integral-circulation-work done, surface integral-flux, Green's theorem in the plane (without proof), Stoke's theorem (without proof), volume integral, Divergence theorem (without proof) and applications of these theorems.

Text Books :

1. B. S. Grewal, Higher Engineering Mathematics, 44th Edition, Khanna publishers, 2017.
2. Erwin Kreyszig, Advanced Engineering Mathematics, 10th Edition, John Wiley & Sons, 2011.

References:

1. Dr.T.K.V.Iyengar, Engineering Mathematics-I,S.Chand publishers
2. R. K. Jain and S. R. K. Iyengar, Advanced Engineering Mathematics, 3/e, Alpha Science International Ltd., 2002
3. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics,Laxmipublication,2008
4. B. V. Ramana, Higher Engineering Mathematics, McGraw Hill Education.

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1	3										
2	3										
3		3									
4	2										
5		3									

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	**14**	20.8	3	**Apply**	**L4**	PO1	Apply	3
2	**15**	22.3	3	Apply	**L3**	PO1	Apply	3
3	**14**	20.8	**3**	Analyze	**L4**	PO2	Analyze	3
4	**9**	13.4	**2**	Understand	**L2**	PO1	Apply	2
5	**15**	22.3	**3**	Evaluate	**L5**	PO2	Analyze	3

CO1: Apply the concepts of ordinary differential equations of first order and first degree.
Action Verb: Apply(L3)
PO1 Verbs: Apply(L3)
CO1 Action Verb is equal to PO1 verb Therefore correlation is high (3).

CO2: Apply the methods of linear differential equations related to various engineering problems.
Action Verb: Apply (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb; Therefore correlation is high (3).

CO3: Analyze the solutions of partial differential equations.
Action Verb: Analyze(L4)
PO2 Verb: Analyze (L4)
CO3 Action Verb level is equal to PO2 verb; Therefore correlation is high (3).

CO4: Understand the different operators and identities in the vector calculus.
Action Verb: Understand(L2)
PO1 Verb: Apply(L3)
CO4 Action Verb is low level to PO1 to one level; Therefore correlation is moderate (2).

CO5: Evaluate the surface integral and volume integral in the vector calculus.
Action Verb: Evaluate(L5)

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PO2 Verb: Analyze (L4)
CO5 Action verb is high level to PO2 verb; therefore the correlation is high (3).

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AES0101	Basic Civil & Mechanical Engineering	3	0	0	3

Course Outcomes:

CO: 1 Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society
CO: 2 Apply the methods of surveying in finding the measurements on Earth surface
CO: 3 Understand the importance of transportation, water resources and environmental engineering
CO: 4 Understand the applications and role of various materials in Mechanical Engineering
CO: 5 Understand the different manufacturing processes and the basics of thermal engineering with its applications
CO: 6 Understand the working of different mechanical power transmission systems, power plants and applications of robotics

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	Various sub-divisions of Civil Engineering		role in ensuring better society	L2
2	Apply	Methods of surveying	finding the measurements	on Earth surface	L3
3	Understand	Importance of transportation, water resources and environmental engineering			L2
4	Understand	applications and role of various materials in Mechanical Engineering			L2
5	Understand	different manufacturing processes and the basics of thermal engineering with its applications			L2
6	Understand	working of different mechanical power transmission systems, power plants and applications of robotics			L2

BASICS OF CIVIL ENGINEERING

(PART-A)

UNIT I

Basics of Civil Engineering:

Role of Civil Engineers in Society- Various Disciplines of Civil Engineering- Structural Engineering- Geo-technical Engineering- Transportation Engineering Hydraulics and Water Resources Engineering - Environmental Engineering-Scope of each discipline - Building Construction and Planning- Construction Materials-Cement - Aggregate - Bricks- Cement concrete- Steel. Introduction to Prefabricated construction Techniques.

UNIT II

Surveying: Objectives of Surveying- Horizontal Measurements- Angular Measurements- Introduction to Bearings Levelling instruments used for levelling -Simple problems on levelling and bearings-Contour mapping.

UNIT III

Transportation Engineering: Importance of Transportation in Nation's economic development- Types of Highway Pavements- Flexible Pavements and Rigid Pavements - Simple Differences. Basics of Harbour, Tunnel, Airport, and Railway Engineering.

Water Resources and Environmental Engineering:

Introduction, Sources of water- Quality of water- Specifications- Introduction to Hydrology–Rainwater Harvesting-Water Storage andConveyance Structures (Simple introduction to Dams and Reservoirs).

Textbooks:

1. Basic Civil Engineering, M.S.Palanisamy, , Tata Mcgraw Hill publications (India) Pvt.Ltd. Fourth Edition.
2. Introduction to Civil Engineering, S.S. Bhavikatti, New Age International Publishers.2022. First Edition.
3. Basic Civil Engineering, Satheesh Gopi, Pearson Publications, 2009, First Edition

Reference Books:

1. Surveying, Vol- I and Vol-II, S.K. Duggal, Tata McGraw Hill Publishers 2019. FifthEdition
2. Hydrology and Water Resources Engineering, Santosh Kumar Garg, KhannaPublishers, Delhi. 2016
3. Irrigation Engineering and Hydraulic Structures - Santosh Kumar Garg, KhannaPublishers, Delhi 2023. 38th Edition
4. Highway Engineering, S.K.Khanna, C.E.G. Justo and Veeraraghavan, Nemchand and Brothers Publications 2019. 10th Edition
5. Indian Standard DRINKING WATER — SPECIFICATION IS 10500-2012

BASICS OF MECHANICAL ENGINEERING (PART-B)

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UNIT I

Introduction to Mechanical Engineering: Role of Mechanical Engineering in Industries and Society- Technologies in different sectors such as Energy, Manufacturing, Automotive, Aerospace, and Marine sectors.

Engineering Materials - Metals-Ferrous and Non-ferrous, Ceramics, Composites, Smart materials.

UNIT II

Manufacturing Processes: Principles of Casting, Forming, joining processes, Machining, Introduction to CNC machines, 3D printing, and Smart manufacturing.

Thermal Engineering – working principle of Boilers, Otto cycle, Diesel cycle, Refrigeration and air-conditioning cycles, IC engines, 2-Stroke and 4-Stroke engines, SI/CI Engines, Components of Electric and Hybrid Vehicles.

UNIT III

Power plants – working principle of Steam, Diesel, Hydro, Nuclear power plants.

Mechanical Power Transmission - Belt Drives, Chain, Rope drives, Gear Drives and their applications.

Introduction to Robotics - Joints & links, configurations, and applications of robotics.

Textbooks:

1. Internal Combustion Engines by V.Ganesan, By Tata McGraw Hill publications (India)Pvt. Ltd.
2. A Tear book of Theory of Machines by S.S. Rattan, Tata McGraw Hill Publications,(India) Pvt. Ltd.
3. An introduction to Mechanical Engg by Jonathan Wicker and Kemper Lewis, Cengage learning India Pvt. Ltd.

Reference Books:

1. Appuu Kuttan KK, Robotics, I.K. International Publishing House Pvt. Ltd. Volume-I
2. 3D printing & Additive Manufacturing Technology- L. Jyothish Kumar, Pulak MPandey, Springer publications
3. Thermal Engineering by Mahesh M Rathore Tata McGraw Hill publications (India) Pvt.Ltd.
4. G. Shanmugam and M.S.Palanisamy, Basic Civil and the Mechanical Engineering, TataMcGraw Hill publications (India) Pvt. Ltd.

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
BCME	CO1	2	2					2						
	CO2	3	2				2							
	CO3	2	2					2						
	CO4	**2**					**2**							
	CO5	**2**						**2**						
	CO6	**2**				**2**		**2**						

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	11/33	33	2	Understand	L2	PO1 PO2 PO7	Apply (L3) Analyze (L3) Thumb Rule	2 2 2

2	12/33	34	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
3	11/33	33	2	Understand	L2	PO1 PO2 PO7	Apply (L3) Analyze (L3) Thumb Rule	2 2 2
4	9/30	30	3	Understand	L2	PO1 PO6	Identify-L3 Thumb Rule	2 2
5	12/30	40	3	Understand	L2	PO1 PO7	Identify-L3 Thumb Rule	2 2
6	9/30	30	3	Understand	L2	PO1 PO5 PO7	Apply(Identify)-L3 Apply-L3 Thumb Rule	2 2 2

Justification Statements:

CO1: Understand various sub-divisions of Civil Engineering and to appreciate their role in ensuring better society.

Action Verb: Understand (L2)

PO1 Verb: **Apply (L3)**

CO1 Action verb is not same level as PO1 verb. Therefore, the correlation is medium (2)

PO2 Verb: **Analyze(L4)**

CO1 Action verb is not same level as PO2 verb. Therefore, the correlation is medium (2)

PO7 Verb: **Thumb Rule**

CO1 correlates medium with PO7. Therefore, the correlation is medium (2)

CO2: Apply the methods of surveying in finding the measurements on Earth surface.

Action Verb: **Apply (L3)**

PO1 Verb: **Apply (L3)**

CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Analyze(L4)**

CO2 Action verb is not same level as PO2 verb. Therefore, the correlation is medium (2)

PO6 Verb: **Thumb Rule**

CO2 correlates medium with PO6. Therefore, the correlation is medium (2)

CO3: Understand the importance of transportation, water resources and environmental engineering.

Action Verb: Understand (L2)

PO1 Verb: **Apply (L3)**

CO3 Action verb is not same level as PO1 verb. Therefore, the correlation is medium (2)

PO2 Verb: **Analyze(L4)**

CO3 Action verb is not same level as PO2 verb. Therefore, the correlation is medium (2)

PO7 Verb: **Thumb Rule**

CO3 correlates medium with PO7. Therefore, the correlation is medium (2)

CO4: Understand the applications and role of various materials in Mechanical Engineering.

Action Verb: **Understand (L2)**

PO1 Verb: **Apply (L3)**

CO4 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)

PO3 Verb: **Review-L2**

CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO7 Verb: **Thumb Rule**

CO4 correlates moderately with PO6. Therefore, the correlation is medium (2).

CO5: Understand the different manufacturing processes and the basics of thermal engineering with its applications.

Action Verb: **Understand (L2)**

PO1 Verb: **Apply (L3)**

CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)

PO3 Verb: **Review-L2**

CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO7 Verb: **Thumb Rule**

CO5 correlates moderately with PO6. Therefore, the correlation is medium (2).

CO6: Understand the working of different mechanical power transmission systems, power plants and applications of robotics.

Action Verb: **Understand (L2)**

PO1 Verb: **Apply (L3)**

CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)

PO3 Verb: **Review-L2**

CO5 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO7 Verb: **Thumb Rule**

CO5 correlates moderately with PO6. Therefore, the correlation is medium (2).

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0101	Engineering Mechanics	3	0	0	3

Course Outcomes:

CO: 1 Apply the concepts of system of forces and frictional forces for contact bodies
CO: 2 Analyze the different force systems to calculate their resultant forces and moments.
CO: 3 Apply the concepts of centroid and moment of inertia for different cross-sections.
CO: 4 Apply the principles of work-energy and impulse-momentum of rectilinear and curvilinear motion of a particle.
CO: 5 Apply the principles of work-energy and impulse-momentum of rigid body

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	Concepts of system of forces and frictional forces	for contact bodies		L3
2	Analyze	To calculate their resultant forces and moments of different force systems			L4
3	Apply	Concepts of centroid and moment of inertia	For different cross-sections		L3
4	Apply	Principles of work-energy and impulse-momentum	Rectilinear and curvilinear motion for a particle		L3
5	Apply	Principles of work-energy and impulse-momentum	Rigid body motion for a particle		L3

UNIT I

Introduction to Engineering Mechanics– Basic Concepts. Scope and Applications
Systems of Forces: Coplanar Concurrent Forces– Components in Space–Resultant–Moment of Force and its Application –Couples and Resultant of Force Systems.
Friction: Introduction**,** limiting friction and impending motion, Coulomb'slaws of dry friction, coefficient of friction, Cone of Static friction.

UNIT II

Equilibrium of Systems of Forces: Free Body Diagrams, Lami's Theorm, Equations of Equilibrium of Coplanar Systems, Graphical method for the equilibrium, Triangle law of forces, converse of the law of polygon of forces condition of equilibrium, Equations of Equilibrium for Spatial System of forces, Numerical examples on spatial system of forces using vector approach, Analysis of plane trusses. Principle of virtual work with simple examples.

UNIT III

Centroid: Centroids of simple figures (from basic principles)–Centroids of Composite Figures.
Centre of Gravity: Centre of gravity of simple body (from basic principles), Centre of gravity of composite bodies, Pappus theorems.

Area Moments of Inertia: Definition– Polar Moment of Inertia, Transfer Theorem, Moments of Inertia of Composite Figures, Products of Inertia, Transfer Formula for Product of Inertia.

Mass Moment of Inertia: Moment of Inertia of Masses, Transfer Formula for Mass Moments of Inertia, Mass Moment of Inertia of composite bodies.

UNIT IV

Rectilinear and Curvilinear motion of a particle: Kinematics and Kinetics –D'Alembert's Principle - Work Energy method and applications to particle motion-Impulse Momentum method.

UNIT V

Rigid body Motion: Kinematics and Kinetics of translation, Rotation about fixed axis and plane motion, Work Energy method and Impulse Momentum method.

Textbooks:

1. Engineering Mechanics, S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., , McGraw Hill Education 2017. 5th Edition.
2. Engineering Mechanics, P.C.Dumir- S.Sengupta and Srinivas V veeravalli , University press. 2020. First Edition.
3. A Textbook of Engineering Mechanics, S.S Bhavikatti. New age internationalpublications 2018. 4th Edition.

Reference Books:

1. Engineering Mechanics, Statics and Dynamics, Rogers and M A. Nelson., McGraw Hill Education. 2017. First Edition.
2. Engineering Mechanics, Statics and Dynamics, I.H. Shames., PHI, 2002. 4th Edition.
3. Engineering Mechanics, Volume-I: Statics, Volume-II: Dynamics, J. L. Meriam and L. G. Kraige., John Wiley, 2008. 6th Edition.
4. Introduction to Statics and Dynamics, Basudev Battachatia, Oxford University Press, 2014. Second Edition
5. Engineering Mechanics: Statics and Dynamics, Hibbeler R.C., Pearson Education, Inc., New Delhi, 2022, 14th Edition

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	2				2							
CO2	2	3		3		3							
CO3	3	2				2							
CO4	3	2				2							
CO5	3	2				2							

Unit No	Course Outcomes					Program Outcome (PO)	PO(s): Action Verb and BTL (for PO1 to PO11)	Level of Correlation (0-3)
	Lesson Plan Hrs	%	Correlation	CO's Action Verb	BTL			
1	15	20	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
2	15	20	3	Analyze	L4	PO1 PO2	Apply (L3) Analyze (L3)	3 3

						PO4 PO6	Analyze (L4) Thumb Rule	3 3
3	15	20	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
4	15	20	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2
5	15	20	3	Apply	L3	PO1 PO2 PO6	Apply (L3) Analyze (L4) Thumb Rule	3 2 2

Justification Statements:

CO1: Apply the concepts of system of forces and frictional forces for contact bodies

Action Verb: **Apply (L3)**

PO1 Verb: **Apply (L3)**

CO1 Action verb is equal to the level of PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Analyze (L4)**

CO1 Action verb is above the level of PO2 verb. Therefore, the correlation is medium (2)

PO6 Verb: **Thumb Rule**

CO1 correlates highly with PO6. Therefore, the correlation is high (3)

CO2: Analyze the different force systems to calculate their resultant forces and moments.

Action Verb: **Analyze (L4)**

PO1 Verb: **Apply (L3)**

CO2 Action verb is above the level of PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Analyze(L4)**

CO2 Action verb is above the level of PO2 verb. Therefore, the correlation is high (3)

PO4 Verb: **Analyze(L4)**

CO2 Action verb is above the level of PO4 verb. Therefore, the correlation is high (3)

PO6 Verb: **Thumb Rule**

CO2 correlates highly with PO6. Therefore, the correlation is high (3)

CO3: Apply the concepts of centroid and moment of inertia for different cross-sections.

Action Verb: **Apply (L3)**

PO1 Verb: **Apply (L3)**

CO3 Action verb is equal to the level of PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Analyze (L4)**

CO3 Action verb is above the level of PO2 verb. Therefore, the correlation is medium (2)

PO6 Verb: **Thumb Rule**

CO3 correlates highly with PO6. Therefore, the correlation is high (3)

CO4: Apply the principles of work-energy and impulse-momentum of rectilinear and curvilinear motion of a particle.

Action Verb: **Apply (L3)**

PO1 Verb: **Apply (L3)**

CO4 Action verb is equal to the level of PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Analyze (L4)**

CO4 Action verb is above the level of PO2 verb. Therefore, the correlation is medium (2)

PO6 Verb: **Thumb Rule**

CO4 correlates highly with PO6. Therefore, the correlation is high (3)

CO5: Apply the principles of work-energy and impulse-momentum of rigid body motion of a particle.

Action Verb: **Apply (L3)**

PO1 Verb: **Apply (L3)**

CO5 Action verb is equal to the level of PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Analyze (L4)**

CO5 Action verb is above the level of PO2 verb. Therefore, the correlation is medium (2)

PO6 Verb: **Thumb Rule**

CO5 correlates highly with PO6. Therefore, the correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AHM9902	Communicative English Lab	0	0	2	1

Course Outcomes:

CO: 1 Understand-the different aspects of the English language proficiency with emphasis on LSRW skills.
CO: 2 Apply communication skills through various language learning activities.
CO: 3 Analyze the English speech sounds, for better listening and speaking.
CO: 4 Evaluate and exhibit professionalism in participating in debates and group discussions.
CO: 5 Analyze themselves to face interviews in future

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the different aspects of the English language proficiency with emphasis on LSRW skills			L2
2	Apply	communication skills through various language learning activities			L3
3	Analyze	the English speech sounds, for better listening and speaking.			L4
4	Evaluate	and exhibit professionalism in participating in debates and group discussions			L5
5	Analyze	themselves to face interviews in future			L4

List ofTopics:

1. Vowels&Consonants (CO3)
2. Non Verbal Communication (CO2)
3. CommunicationSkills(CO2)
4. RolePlayor ConversationalPractice (CO1,CO2)
5. E-mailWriting (CO1)
6. Just A Minute (CO1,CO2)
7. GroupDiscussions-methods&practice (CO4)
8. Debates-Methods&Practice (CO4)
9. PPTPresentations/PosterPresentation (CO2)
10. InterviewsSkills (CO5)

SuggestedSoftware:

- WaldenInfotech
- YoungIndiaFilms

ReferenceBooks:

1. RamanMeenakshi,Sangeeta-Sharma.*TechnicalCommunication*.OxfordPress.2018.
2. TaylorGrant:*EnglishConversationPractice*,TataMcGraw-HillEducationIndia,2016
3. Hewing's,Martin.Cambridge*AcademicEnglish*(B2).CUP,2012.
4. J.Sethi&P.V.Dhamija.*ACourse inPhoneticsandSpoken English*,(2nd Ed),Kindle,2013.

WebResources:

SpokenEnglish:

1. www.esl-lab.com
2. www.englishmedialab.com
3. www.englishinteractive.net
4. https://www.britishcouncil.in/english/online
5. http://www.letstalkpodcast.com/
6. https://www.youtube.com/c/mmmEnglish_Emma/featured
7. https://www.youtube.com/c/ArnelsEverydayEnglish/featured
8. https://www.youtube.com/c/engvidAdam/featured
9. https://www.youtube.com/c/EnglishClass101/featured
10. https://www.youtube.com/c/SpeakEnglishWithTiffani/playlists
11. https://www.youtube.com/channel/UCV1h_cBE0Drdx19qkTM0WNw

Voice&Accent:

1. https://www.youtube.com/user/letstalkaccent/videos
2. https://www.youtube.com/c/EngLanguageClub/featured
3. https://www.youtube.com/channel/UC_OskgZBoS4dAnVUgJVexc
4. https://www.youtube.com/channel/UCNfm92h83W2i2ijc5Xwp_IA

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1										2	
2									2	2	
3										3	
4									3	3	
5										3	

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	corr	Verb	BTL			
1				Understand	L2	10	Thumb Rule	2
2				Apply	L3	9,10	Thumb Rule	2,2
3				Analyze	L4	10	Thumb Rule	3
4				Evaluate	L5	9,10	Thumb Rule	3,3
5				Analyze	L4	10	Thumb Rule	3

CO1: Understand the different aspects of the English language proficiency with emphasis on LSRW skills
Action Verb: Understand (L2)

CO1 Action Verb is understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Apply communication skills through various language learning activities.
Action Verb: Apply (L3)
CO2 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate(2).

CO3: Analyze the English speech sounds, for better listening and speaking.
Action Verb: Analyze (L4)
CO3 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

CO4: Evaluate and exhibit professionalism in participating in debates and group discussions.
Action Verb: Evaluate (L5)

CO4 Action Verb is Evaluate of BTL 5. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).

CO5: Analyze themselves to face interviews in future.
Action Verb: Develop (L4)

CO5 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23ABS9907	Engineering Chemistry Lab	0	0	2	1

Course Outcomes:

CO: 1 Estimate the hardness of water.
CO: 2 Prepare advanced polymer materials.
CO: 3 Measure the strength of an acid present in secondary batteries.
CO: 4 Estimate the Iron and Calcium in cement.
CO: 5 Determine the physical properties like surface tension, adsorption and viscosity

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Estimate**	Hardness of water			**L5**
2	**Prepare**	Advanced polymer Bakelite materials			**L4**
3	**Measure**	Strength of an acid present in secondary batteries.			**L4**
4	**Estimate**	Iron and Calcium in cement			**L5**
5	**Determine**	Physical properties like surface tension, adsorption and viscosity			**L4**

List of Experiments:

1. Determination of Hardness of a groundwater sample (CO1)
2. Estimation of Dissolved Oxygen by Winkler's method (CO3)
3. Determination of Strength of an acid in Pb-Acid battery (CO3)
4. Preparation of a polymer (Bakelite) (CO2)
5. Determination of percentage of Iron in Cement sample by colorimetry (CO4)
6. Estimation of Calcium in port land Cement (CO4)
7. Preparation of nanomaterials by precipitation method (CO5)
8. Adsorption of acetic acid by charcoal (CO4)
9. Determination of percentage Moisture content in a coal sample (CO4)
10. Determination of Viscosity of lubricating oil by Redwood Viscometer 1(CO5)
11. Determination of Viscosity of lubricating oil by Redwood Viscometer 2 (CO5)
12. Estimation of copper by Iodometry (CO3)

Note: Any TEN of the listed experiments are to be conducted. Out of which any TWO Experiments may be conducted in virtual mode.

Reference:

Vogel's Quantitative Chemical Analysis 6th Edition 6th Edition

Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1				3									
2				3									
3				3									
4				3									
5				3									

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(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1				Estimate	L5	PO4	PO4: Analyze (L5)	3
2				Prepare	L4	PO4	PO4: Analyze (L4)	3
3				Measure	L4	PO4	PO4: Analyze (L4)	3
4				Estimate	L5	PO4	PO4: Analyze (L5)	3
5				Determine	L4	PO4	PO4: Analyze (L4)	3

CO1: Estimate the hardness of water.

Action Verb: Estimate (L5)

PO4 Verb: Analyze (L4)

CO1 Action Verb is greater than PO4; Therefore correlation is high (3)

CO2: Prepare advanced polymer Bakelite materials.

Action Verb: Prepare **(L4)**

PO4 Verb: Analyze (L4)

CO2 Action Verb is equal to PO4 verb; Therefore, correlation is high (3)

CO3: Measure the strength of an acid present in secondary batteries.

Action Verb: Measure **(L4)**

PO4 Verb: Analyze (L4)

CO3 Action Verb is equal to PO4 verb; Therefore, correlation is high (3)

CO4: Estimate the Iron and Calcium in cement.

Action Verb: Estimate **(L5)**

PO4 Verb: Analyze (L4)

CO4 Action Verb is greater than PO4; Therefore correlation is high (3)

CO5: Determine the physical properties like surface tension, adsorption and viscosity.

Action Verb: Determine (L4)

PO4 Verb: Analyze (L4)

CO5 Action Verb is equal to PO4 verb; Therefore, correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I/II** **Branch of Study: Common to all Branches**

Subject Code	Subject Name	L	T	P	Credits
23AES0302	Engineering Workshop	0	0	3	1.5

Course Outcomes:

CO: 1 Apply the wood working skills to prepare different joints.
CO: 2 Analyze the sheet metal and fitting operations to prepare various components
CO: 3 Apply the basic electrical engineering knowledge for house wiring practice.
CO: 4 Apply the Welding process for Lap and Butt Joints.
CO: 5 Understand the various plumbing pipe joints

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the wood working skills to prepare different joints			L3
CO2	Analyze	the sheet metal and fitting operations to prepare various components			L4
CO3	Apply	the basic electrical engineering knowledge for house wiring practice			L3
CO4	Apply	the Welding process for Lap and Butt joints			L3
CO5	Understand	the various plumbing pipe joints			L2

SYLLABUS

1. **Demonstration**: Safety practices and precautions to be observed in workshop.
2. **Wood Working:** Familiarity with different types of woods and tools used in wood working and make following joints.
   a) Half – Lap joint b) Mortise and Tenon joint c) Corner Dovetail joint or Bridlejoint
3. **Sheet Metal Working**: Familiarity with different types of tools used in sheet metal working, Developments of following sheet metal job from GI sheets.
   a) Tapered tray b) Conical funnel c) Elbow pipe d) Brazing
4. **Fitting:** Familiarity with different types of tools used in fitting and do the following fitting exercises.
   a) V-fit b) Dovetail fit c) Semi-circular fit d) Bicycle tire puncture and change of two-wheeler tyre
5. **Electrical Wiring**: Familiarity with different types of basic electrical circuits and makethe following connections.
   a) Parallel and series b) Two-way switch c) Godown lighting
   d) Tube light e) Three phase motor f) Soldering of wires
6. **Foundry Trade:** Demonstration and practice on Moulding tools and processes, Preparation of Green Sand Moulds for given Patterns.
7. **Welding Shop**: Demonstration and practice on Arc Welding and Gas welding. Preparation of Lap joint and Butt joint.
8. **Plumbing:** Demonstration and practice of Plumbing tools, Preparation of Pipe joints with coupling for same diameter and with reducer for different diameters.

Textbooks:

1. Basic Workshop Technology: Manufacturing Process, Felix W.; Independently

Published,2019. Workshop Processes, Practices and Materials; Bruce J. Black, Routledge publishers, 5th Edn. 2015.
2. A Course in Workshop Technology Vol I. & II, B.S. Raghuwanshi, Dhanpath Rai & Co., 2015 & 2017.

Reference Books:

1. Elements of Workshop Technology, Vol. I by S. K. Hajra Choudhury & Others, Media Promoters and Publishers, Mumbai. 2007, 14th edition
2. Workshop Practice by H. S. Bawa, Tata-McGraw Hill, 2004.

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3	3	3						3			3	3
CO2	3	3	3						3			3	3
CO3	3	3	3						3			3	3
CO4	3	3	3						3			3	3
CO5	2	2	2						2			3	3

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	-	-	3	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
2	-	-	3	Analyze	L4	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
3	-	-	1	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
4	-	-	2	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	3 3 3 3
5	-	-	2	Understand	L2	PO1 PO2 PO3 PO9	Apply-L3 Review-L2 Develop-L3 Thumb Rule-L3	2 2 2 2

Justification Statements:

CO1: Apply the wood working skills to prepare different joints

Action Verb: **Apply** (L3)
PO1 Verb: **Apply** (L3)
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO1 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb Rule**

CO1 Action verb is same level as PO9 verb. Therefore, the correlation is high (3)

CO2: Analyze the sheet metal and fitting operations to prepare various components

Action Verb: **Analyse** (L4)

PO1 Verb: **Apply** (L3)
CO2 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO2 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb Rule**
CO2 Action verb is same level (greater) as PO9 verb. Therefore, the correlation is high (3)

CO3: Apply the basic electrical engineering knowledge for house wiring practice

Action Verb: **Apply** (L3)

PO1 Verb: **Apply** (L3)
CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO3 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO3 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb Rule**
CO3 Action verb is same level as PO9 verb. Therefore, the correlation is high (3)

CO4: Apply the Welding process for Lap and Butt Joints

Action Verb: **Apply** (L3)

PO1 Verb: **Apply** (L3)
CO4 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb Rule**
CO4 Action verb is same level as PO9 verb. Therefore, the correlation is high (3)

CO5: Understand the various plumbing pipe joints.

Action Verb: **Understand (L2)**
PO1 Verb: **Apply** (L2)
CO5 Action verb is less than as PO1 verb. Therefore, the correlation is high (2)
PO2 Verb: **Review (L2)**
CO5 Action verb is less than as PO2 verb. Therefore, the correlation is high (2)
PO3 Verb: **Develop (L3)**
CO5 Action verb is less than as PO3 verb. Therefore, the correlation is high (2)
PO9 Verb: **Thumb Rule**
CO5 Action verb is less than as PO9 verb. Therefore, the correlation is high (2)

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MECHANICAL ENGINEERING (ME)

Year: I **Semester: I/II** **Branch of Study: Common to all Branches**

Subject Code	Subject Name	L	T	P	Credits
23APC0301	Engineering Mechanics Lab	0	0	3	1.5

Course Outcomes:

CO: 1 Evaluate the coefficient of friction between two different surfaces and between the inclined plane and the roller.
CO: 2 Verify Law of Polygon of forces and Law of Moment using force polygon and bell crank lever.
CO: 3 Determine the Centre of gravity and Moment of Inertia of different configurations
CO: 4 Verify the equilibrium conditions of a rigid body under the action of different force systems.
CO: 5 Determine acceleration due to gravity using a compound pendulum.

Students have to perform any 10 of the following Experiments:

1. Verification of Law of Parallelogram of Forces.
2. Verification of Law of Triangle of Forces.
3. Verification of the Law of polygon for coplanar-concurrent forces acting on a particle in equilibrium and to find the value of unknown forces considering particle to be in equilibrium using universal force table.
4. Determination of coefficient of Static and Rolling Frictions
5. Determination of Centre of Gravity of different shaped Plane Lamina.
6. Verification of the conditions of equilibrium of a rigid body under the action of coplanar non-concurrent, parallel force system with the help of a simply supported beam.
7. Study of the systems of pulleys and draw the free body diagram of the system.
8. Determine the acceleration due to gravity using a compound pendulum.
9. Determine the Moment of Inertia of the compound pendulum about an axis perpendicular tothe plane of oscillation and passing through its centre of mass.
10. Determine the Moment of Inertia of a Flywheel.
11. Verification of Law of Moment using Rotation Disc Apparatus and Bell Crank Lever.

References:

1. S. Timoshenko, D. H. Young, J.V. Rao, S. Pati., Engineering Mechanics, 5th Edition, McGraw Hill Education.
2. Hibbeler R.C., Engineering Mechanics: Statics and Dynamics, 14th Edition, Pearson Education,Inc., New Delhi, 2022

CO/PO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	3		2										
CO2	3	2											
CO3	3			1									
CO4	3												
CO5	3				3								

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AHM9903	Health and Wellness, Yoga and Sports	-	-	1	0.5

Course Outcomes:

CO: 1 Understand the health & fitness by diet
CO: 2 Understand the importance of yoga.
CO: 3 Apply The yoga practices including Surya Namaskar
CO: 4 Understand the importance of sports.
CO: 5 Analyze various activities that help enhance their health & Positive Personality

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	Health & fitness by diet			**L2**
2	**Understand**	Importance of yoga.			**L2**
3	**Apply**	yoga practices including Surya Namaskar			**L3**
4	**Understand**	Importance of sports			**L2**
5	**Analyze**	Various activities that help enhance their health & Positive Personality			**L4**

UNIT I

Concept of health and fitness, Nutrition and Balanced diet, basic concept of immunity Relationship between diet and fitness, Globalization and its impact on health, Body Mass Index (BMI) of all age groups.

Activities:

i) Organizing health awareness programmes in community
ii) Preparation of health profile
iii) Preparation of chart for balance diet for all age groups

UNIT II

Concept of yoga, need for and importance of yoga, origin and history of yoga in Indian context, classification of yoga, Physiological effects of Asanas- Pranayama and meditation, stress management and yoga, Mental health and yoga practice.

Activities:

Yoga practices – Asana, Kriya, Mudra, Bandha, Dhyana, Surya Namaskar

UNIT III

Concept of Sports and fitness, importance, fitness components, history of sports, Ancient and Modern Olympics, Asian games and Commonwealth games.

Activities:

i) Participation in one major game and one individual sport viz., Athletics, Volleyball, Basketball, Handball, Football, Badminton, Kabaddi, Kho-kho, Table tennis, Cricket etc.

Practicing general and specific warm up, aerobics

ii) Practicing cardiorespiratory fitness, treadmill, run test, 9 min walk, skipping and running.

Reference Books:

1. Gordon Edlin, Eric Golanty. Health and Wellness, 14th Edn. Jones & Bartlett Learning,2022
2. T.K.V.Desikachar. The Heart of Yoga: Developing a Personal Practice
3. Archie J.Bahm. Yoga Sutras of Patanjali, Jain Publishing Company, 1993
4. Wiseman, John Lofty, SAS Survival Handbook: The Ultimate Guide to SurvivingAnywhere Third Edition, William Morrow Paperbacks, 2014
5. The Sports Rules Book/ Human Kinetics with Thomas Hanlon. -- 3rd ed. HumanKinetics, Inc.2014

General Guidelines:

1. Institutes must assign slots in the Timetable for the activities of Health/Sports/Yoga.
2. Institutes must provide field/facility and offer the minimum of five choices of as manyas Games/Sports.
3. Institutes are required to provide sports instructor / yoga teacher to mentor the students.

Evaluation Guidelines:

- Evaluated for a total of 100 marks.
- A student can select 6 activities of his/her choice with a minimum of 01 activity per unit. Each activity shall be evaluated by the concerned teacher for 15 marks, totalingto 90 marks.
- A student shall be evaluated by the concerned teacher for 10 marks by conducting viva in the subject
- Mapping of COs to POs and PSOs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1						2	2						
2						2	2						
3						2	2						
4						2	2						
5						3	3						

- (Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1					Understand	L2	P06,P07	2
2					Understand	L2	P06,P07	2
3					Apply	L3	P06,P07	2
4					Understand	L2	P06,P07	2
5					Analyze	L4	P06,P07	3

CO1: Understand the health & fitness by diet
Action Verb: Understand (L2)
CO1 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

CO2: Understand the Importance of yoga
Action Verb: Understand (L2)
CO2 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

CO3: APPLY

yoga practices including Surya Namaskar

Action Verb: APPLY (L3)

CO3 Action Verb is APPLY of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

CO4: .Understand Importance of sports

Action Verb: Understand (L2)

CO4 Action Verb is **Understand** of BTL 2.Using Thumb rule; L2 correlates PO6 and PO7 as a moderate (2)

Action Verb: APPLY (L3)

CO5: Analyze the Various activities that help enhance their health & Positive Personality

Action Verb: Analyze (L4)

CO5 Action Verb is Analyze of BTL 2.Using Thumb rule; L4 correlates PO6 and PO7 as a moderate (2)

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Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23ABS9911	Numerical Methods and Transform Techniques	3	0	0	3

Course Outcomes:

CO: 1 Analyze relevant numerical techniques for interpolation and concepts of curve fitting
CO: 2 Apply the different iteration methods to solve Algebraic, Transcendental and Simultaneous Equations.
CO: 3 Evaluate different numerical methods with accuracy and efficiency for ordinary differential equations
CO: 4 Apply the Laplace transform techniques for solving differential equations (continuous systems).
CO: 5 Apply Fourier series and Fourier transform in Communication theory and signal analysis.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Analyze	relevant numerical techniques	for interpolation and concepts of curve fitting		L4
2	Apply	the different iteration methods	To solve Algebraic, Transcendental and Simultaneous Equations.		L3
3	Evaluate	different numerical methods with accuracy and efficiency	for ordinary differential equations		L5
4	Apply	Laplace Transform techniques for continuous functions	To solve differential equations.		L3
5	Apply	Fourier series and Fourier transform	in Communication theory and signal analysis		L3

UNIT – I: Interpolation **9hrs**

Finite forward and backward differences-Newton's forward and Newton's backward interpolation formulae – Lagrange's formula.
Curve fitting: By the method of least squares Fitting of straight line, second-degree polynomial and Exponential curve.

UNIT – II: Solution of Algebraic & Transcendental Equations **9hrs**

Introduction-Bisection Method-Iterative method, Regula-falsi method and Newton Raphson method.
System of Algebraic equations: LU decomposition, Gauss Elimination, Jacobi methods and Gauss Seidal iterative method.

UNIT – III: Solution of Initial value problems to Ordinary differential equations **9hrs**

Numerical solutions of Ordinary Differential equations: Taylor's series-Picard's Method of successive Approximations-Euler's and modified Euler's methods-Runge-Kutta methods (second and fourth order).

UNIT-IV: Laplace Transforms **10hrs**

Definition-Laplace transform of standard functions-existence of Laplace Transform – Inverse transform – First shifting Theorem, transforms of derivatives and integrals – Unit step function – Second shifting theorem– Convolution theorem – Laplace transform of Periodic function. Solving linear ordinary differential equations with constant coefficients using Laplace transforms.

UNIT-V: Fourier series and Fourier transforms **10hrs**

Fourier series: Periodic function, Determination of Fourier coefficients (Euler's) – Dirichlet conditions for the existence of Fourier series – Fourier series of Even and odd functions – Fourier series in an arbitrary interval – Half-range Fourier sine and cosine expansions.

Fourier transforms: Fourier integral theorem (without proof) – Fourier sine and cosine integrals-complex form of Fourier integral. Fourier transform – Fourier sine and cosine transforms – Properties – Inverse transforms – convolution theorem.

TEXT BOOKS:

1.S S Sastry, Introductory Methods of Numerical Analysis, PHI Learning Private Limited.
2. B.S.Grewal, Higher Engineering Mathematics, Khanna Pulishers, 2017,44th Edition.
3.R.K.Jain and S.R.K.Iyengar, Advanced Engineering Mathematics, Alpha Science International Ltd., 2021 5th Edition (9th reprint).

REFERENCES:

1. ErwinKreyszig, Advanced Engineering Mathematics, John Wiley & Sons, 2018, 10th Edition.
2. H.K Das, Er.Rajnish Verma, Higher Engineering Mathematics, S.Chand Publications, 2014, Third Edition (Reprint 2021)
3. Alan Jeffrey, Advanced Engineering Mathematics, Elsevier
4. T.K.V.Iyengar, B.Krishna Gandhi, S.Ranganatham,M.V.V.S.N.Prasad, Numerical Methods, S.Chand Publications

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc17_ma14/preview
2. https://onlinecourses.nptel.ac.in/noc24_ma05/preview
3. http://nptel.ac.in/courses/111105090

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1		3									
2	3										
3		3									
4	3										
5	3										

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Action Verb	BTL			
1				**Analyze**	**L4**	PO2	**Analyze(L4)**	3
2				**Apply**	**L3**	PO1	**Apply(L3)**	3
3				**Evaluate**	**L5**	PO2	**Analyze(L4)**	3
4				**Apply**	**L3**	PO1	**Apply(L3)**	3
5				**Apply**	**L3**	PO1	**Apply(L3)**	3

CO1: Analyze relevant numerical techniques for interpolation and concepts of curve fitting.

Action Verb: Analyze (L4)

PO2 Verbs: **Analyze** (L4)

CO1 Action Verb is equal to PO2 verb; Therefore correlation is high (3).

CO2: Apply the different iteration methods to solve Algebraic, Transcendental and Simultaneous Equations.

Action Verb: Apply (L3)

PO1 Verbs: **Apply** (L3)

CO2 Action Verb is equal to PO1 verb; Therefore correlation is high(3).

CO3: Evaluate different methods in numerical analysis with accuracy and efficiency of solutions.

Action Verb: Evaluate (L5)

PO2 Verb: Analyze (L4)

CO3 Action Verb is high level to PO2 verb; Therefore correlation is high (3).

CO4: Apply the Laplace transform techniques for solving differential equations (continuous systems).

Action Verb: Apply **(L3)**

PO1 Verb: Apply (L3)

CO4 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

CO5: Apply Fourier series and Fourier transform in Communication theory and signal analysis.

Action Verb: Apply **(L3)**

PO1 Verb: Apply (L3)

CO5 Action verb is equl to PO2 verb; therefore the correlation is high (3).

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Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AHM9905	Universal Human Values	2	1	0	3

Course Outcomes:

CO: 1 Understand the essentials of human values, self-exploration, happiness and prosperity for value added education.
CO: 2 Analyze the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.
CO: 3 Apply the nine universal human values in relationships for harmony in the family and orderliness in the society.
CO: 4 Evaluate the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.
CO: 5 Apply the holistic understanding of harmony on professional ethics through augmenting universal human order

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	**the essentials of human values, self-exploration, happiness and prosperity for value added education.**			L2
2	Analyze	**the harmony in the human being as sentient 'I' and the material 'Body' in various aspects.**			L4
3	Apply	**the nine universal human values in relationships for harmony in the family and orderliness in the society.**			L3
4	Evaluate	**the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.**			L5
5	Apply	**the holistic understanding of harmony on professional ethics through augmenting universal human order.**			L3

UNIT I Introduction to Value Education (6 lectures and 3 tutorials for practice session)

Lecture 1: Right Understanding, Relationship and Physical Facility (Holistic Development and the Role of Education)

Lecture 2: Understanding Value Education

Tutorial 1: Practice Session PS1 Sharing about Oneself

Lecture 3: self-exploration as the Process for Value Education

Lecture4: Continuous Happiness and Prosperity – the Basic Human Aspirations

Tutorial 2: Practice Session PS2 Exploring Human Consciousness

Lecture 5: Happiness and Prosperity – Current Scenario

Lecture 6: Method to Fulfill the Basic Human Aspirations

Tutorial 3: Practice Session PS3 Exploring Natural Acceptance

UNIT II Harmony in the Human Being (6 lectures and 3 tutorials for practice session)
Lecture 7: Understanding Human being as the Co-existence of the self and the body.
Lecture 8: Distinguishing between the Needs of the self and the body
Tutorial 4: Practice Session PS4 Exploring the difference of Needs of self and body.
Lecture 9: The body as an Instrument of the self
Lecture 10: Understanding Harmony in the self
Tutorial 5: Practice Session PS5 Exploring Sources of Imagination in the self
Lecture 11: Harmony of the self with the body
Lecture 12: Programme to ensure self-regulation and Health
Tutorial 6: Practice Session PS6 Exploring Harmony of self with the body

UNIT III Harmony in the Family and Society (6 lectures and 3 tutorials for practice session)
Lecture 13: Harmony in the Family – the Basic Unit of Human Interaction
Lecture 14: 'Trust' – the Foundational Value in Relationship
Tutorial 7: Practice Session PS7 Exploring the Feeling of Trust
Lecture 15: 'Respect' – as the Right Evaluation
Tutorial 8: Practice Session PS8 Exploring the Feeling of Respect
Lecture 16: Other Feelings, Justice in Human-to-Human Relationship
Lecture 17: Understanding Harmony in the Society
Lecture 18: Vision for the Universal Human Order
Tutorial 9: Practice Session PS9 Exploring Systems to fulfil Human Goal

UNIT IV Harmony in the Nature/Existence (4 lectures and 2 tutorials for practice session)
Lecture 19: Understanding Harmony in the Nature
Lecture 20: Interconnectedness, self-regulation and Mutual Fulfilment among the Four Orders of Nature
Tutorial 10: Practice Session PS10 Exploring the Four Orders of Nature
Lecture 21: Realizing Existence as Co-existence at All Levels
Lecture 22: The Holistic Perception of Harmony in Existence
Tutorial 11: Practice Session PS11 Exploring Co-existence in Existence.

UNIT V Implications of the Holistic Understanding – a Look at Professional Ethics (6 lectures and 3 tutorials for practice session)
Lecture 23: Natural Acceptance of Human Values
Lecture 24: Definitiveness of (Ethical) Human Conduct
Tutorial 12: Practice Session PS12 Exploring Ethical Human Conduct
Lecture 25: A Basis for Humanistic Education, Humanistic Constitution and Universal Human Order
Lecture 26: Competence in Professional Ethics
Tutorial 13: Practice Session PS13 Exploring Humanistic Models in Education
Lecture 27: Holistic Technologies, Production Systems and Management Models-Typical Case Studies
Lecture 28: Strategies for Transition towards Value-based Life and Profession
Tutorial 14: Practice Session PS14 Exploring Steps of Transition towards Universal Human Order

Textbook and Teachers Manual

a. The Textbook

R R Gaur, R Asthana, G P Bagaria, *A Foundation Course in Human Values and Professional Ethics*, 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-47-1

b. The Teacher's Manual

R R Gaur, R Asthana, G P Bagaria,*Teachers' Manual for A Foundation Course in Human Values and Professional Ethics,* 2nd Revised Edition, Excel Books, New Delhi, 2019. ISBN 978-93-87034-53-2

Reference Books:

1. *JeevanVidya: EkParichaya,* A Nagaraj, JeevanVidyaPrakashan, Amarkantak, 1999.
2. *Human Values*, A.N. Tripathi, New Age Intl. Publishers, New Delhi, 2004.
3. *The Story of Stuff* (Book).
4. *The Story of My Experiments with Truth* - by Mohandas Karamchand Gandhi
5. *Small is Beautiful* - E. F Schumacher.
6. *Slow is Beautiful* - Cecile Andrews
7. *Economy of Permanence* - J C Kumarappa
8. *Bharat Mein Angreji Raj* – PanditSunderlal
9. *Rediscovering India* - by Dharampal
10. *Hind Swaraj or Indian Home Rule* - by Mohandas K. Gandhi
11. *India Wins Freedom* - Maulana Abdul Kalam Azad
12. *Vivekananda* - Romain Rolland (English)
13. *Gandhi* - Romain Rolland (English)

Online Resources:

1. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%201-Introduction%20to%20Value%20Education.pdf
2. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%202-Harmony%20in%20the%20Human%20Being.pdf

3. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%203-Harmony%20in%20the%20Family.pdf
4. https://fdp-si.aicte-india.org/UHV%201%20Teaching%20Material/D3-S2%20Respect%20July%2023.pdf
5. https://fdp-si.aicte-india.org/UHV-II%20Class%20Notes%20&%20Handouts/UHV%20Handout%205-Harmony%20in%20the%20Nature%20and%20Existence.pdf
6. https://fdp-si.aicte-india.org/download/FDPTeachingMaterial/3-days%20FDP-SI%20UHV%20Teaching%20Material/Day%203%20Handouts/UHV%203D%20D3-S2A%20Und%20Nature-Existence.pdf
7. https://fdp-si.aicte-india.org/UHV%20II%20Teaching%20Material/UHV%20II%20Lecture%2023-25%20Ethics%20v1.pdf
8. https://www.studocu.com/in/document/kiet-group-of-institutions/universal-human-values/chapter-5-holistic-understanding-of-harmony-on-professional-ethics/62490385
9. https://onlinecourses.swayam2.ac.in/aic22_ge23/preview

Articulation matrix

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
UNIVERSAL HUMAN	CO1								2			2		
	CO2							3	3					
	CO3						2	2	2					
	CO4						3	3	3			3		
	CO5						2	2	2			2		

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CO-PO mapping justification:

Correlation matrix

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1			2	**Understand**	**2**	PO8,PO11	Thumb Rule	2,2
2			3	**Analyze**	**4**	PO7,PO8	Thumb Rule	3,3
3			**2**	**Apply**	**3**	PO6,PO7,PO8	Thumb Rule	2,2,2
4			**3**	**Evaluate**	**5**	PO6,PO7,PO8,PO11	Thumb Rule	3,3,3,3
5			**2**	**Apply**	**3**	PO6,PO7,PO8,PO11	Thumb Rule	2,2,2,2

Justification Statements:

CO1: Understand the essentials of human values, self-exploration, happiness and prosperity for value added education.
Action Verb: Understand (L2)
CO1 Action Verb is Understand of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).
CO2: Analyze the harmony in the human being as sentient ‘I’ and the material ‘Body’ in various aspects.
Action Verb: Analyze (L4)
CO2 Action Verb is Analyze of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3).
CO3: Apply the nine universal human values in relationships for harmony in the family and orderliness in the society.
Action Verb: Apply (L3)
CO3 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2)
CO4: Evaluate the interconnectedness of four orders of nature and holistic perception of harmony at all levels of existence.
Action Verb: Evaluate (L5)
CO4 Action Verb is Evaluate of BTL5. Using Thumb rule, L5 correlates PO6 to PO11 as high (3).
CO5: Apply the holistic understanding of harmony on professional ethics through augmenting universal human order.
Action Verb: Apply (L3)
CO5 Action Verb is Apply of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AES0303	Thermodynamics	2	0	0	2

Course Outcomes:

CO: 1 Understand the concept of thermodynamics system and properties.
CO: 2 Analyze the thermodynamics laws.
CO: 3 Analyze the concept of entropy, Maxwell relations, Helmholtz Functions.
CO: 4 Understand the concept of steam formations and its process.
CO: 5 Evaluate the difference between refrigeration and air conditioning.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concept of thermodynamics system and properties			L2
CO2	Analyze	the thermodynamics laws			L4
CO3	Analyze	the concept of entropy, Maxwell relations, Helmholtz Functions.			L2
CO4	Understand	the concept of steam formations and its process			L4
CO5	Evaluate	the difference between refrigeration and air conditioning.			L4

Unit I:

Introduction: Basic Concepts: System, boundary, Surrounding, control volume, Universe, Types of Systems, Macroscopic and Microscopic viewpoints, Concept of Continuum, Thermodynamic Equilibrium, State, Property, Process, Cycle – Reversibility – Quasi static Process, Irreversible Process, Causes of Irreversibility.

Unit II

Energy in State and in Transition, Types, Work and Heat, Point and Path function. Zeroth Law of Thermodynamics – PMM-I, Joule's Experiment – First law of Thermodynamics and applications. Limitations of the First Law – Enthalpy, Thermal Reservoir, Heat Engine, Heat pump, Parameters of performance.

Unit III

Second Law of Thermodynamics, Kelvin-Planck and Clausius Statements and their Equivalence / Corollaries, PMM-II, Carnot's principle, Carnot cycle and its specialties, Thermodynamic scale of Temperature, Clausius Inequality, Entropy, Principle of Entropy Increase – Energy Equation, Availability and Irreversibility – Thermodynamic Potentials, Gibbs and Helmholtz Functions, Maxwell Relations – Elementary Treatment of the Third Law of Thermodynamics.

Unit IV

Pure Substances, P-V-T- surfaces, T-S and h-s diagrams, Mollier Charts, Phase Transformations – Triple point at critical state properties during change of phase, Dryness Fraction – Clausius – Clapeyron Equation Property tables. Mollier charts – Various Thermodynamic processes and energy Transfer – Steam Calorimetry.

Unit V

Introduction to Refrigeration: working of Air, Vapour compression, VCR system Components, COP Refrigerants.

Introduction to Air Conditioning: Psychrometric properties & processes – characterization of sensible and latent heat loads – load concepts of SHF.

Requirements of Air standard cycles and vapour Cycles.

Text Books:

1. P.K. Nag, Engineering Thermodynamics, 5/e, Tata McGraw Hill, 2013.
2. Claus Borgnakke Richard E. Sonntag, Fundamentals of Thermodynamics, 7/e, Wiley, 2009.

Reference Books:

1. J.B. Jones, and R.E. Dugan, Engineering Thermodynamics, 1/e, Prentice Hall, 1995.
2. Y.A. Cengel & M.A. Boles, Thermodynamics – An Engineering Approach, 7/e, McGraw Hill, 2010.
3. P. Chattopadhyay, Engineering Thermodynamics, 1/e, Oxford University Press, 2011.
4. CP Arora, Refrigeration and Air-conditioning, 4/e, McGraw Hill, 2021.

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Thermodynamics	CO1	3	3		3								2	2
	CO2	3	3		3								2	2
	CO3	2	3		1								3	3
	CO4	3	3		3								3	3
	CO5	3	3		3								2	2

Online Learning Resources:

- https://www.edx.org/learn/thermodynamics.
- https://archive.nptel.ac.in/courses/112/106/112106310.
- https://www.youtube.com/watch?v=7NI5P4KqrAs&t=1s
- https://kp.kiit.ac.in/pdf_files/02/Study-Material_3rd-
- Semester_Winter_2021_Mechanical-Engg.-_Thermal-Engineering-1_Abhijit-Samant.pdf
- https://www.coursera.org/learn/thermodynamics-intro

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			

Justification Statements

CO1: Apply the thermodynamic properties and steam properties to derive the steam-based problems Action Verb: Apply (L3)

PO1 Verb: Apply (L3)

CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: Review (L2)

CO1 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)

PO4 Verb: Analyse (L4)

CO1 Action verb is less than level as PO4 verb. Therefore, the correlation is high (3)

CO2: Analyse the laws of thermodynamics to heat-pumps, heat engines, and refrigerators Action Verb: Analyse (L4)

PO1 Verb: Apply (L3) CO2 Action verb is greater than level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: Review (L2)

CO2 Action verb is greater than as PO2 verb. Therefore, the correlation is high (3)

PO4 Verb: Analyse (L4)

CO2 Action verb is as same level as PO4 verb. Therefore, the correlation is high (3)

CO3: Understand the concepts of entropy and availability of the systems Action Verb: Understand (L2)

Action Verb: Understand (L2)

PO1 Verb: Apply (L3)

CO3 Action verb is less than level as PO1 verb by one level. Therefore, the correlation is medium (2)

PO2 Verb: Review (L2)

CO3 Action verb is as same level as PO2 verb. Therefore, the correlation is high (3)

PO4 Verb: Analyse (L4)

CO3 Action verb is less than level as PO4 verb by two levels. Therefore, the correlation is low (1) CO4: Analyse the concepts of idea gas equation, gas and vapour mixture and perfect gases Action Verb: Analyse (L4)

PO1 Verb: Apply (L3)

CO4 Action verb is greater than level as PO1 verb. Therefore, the correlation is High (3)

PO2 Verb: Review (L2)

CO4 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)

PO7 Verb: Understand (L2)

CO4 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)

CO5: Evaluate the TdS equations and Maxwell reactions

Action Verb: Evaluate (L5)

PO1 Verb: Apply (L3)

CO5 Action verb is greater than PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: Review (L2)

CO5 Action verb is greater than PO2 verb. Therefore, the correlation is high (3)

PO7 Verb: Understand (L2)

CO5 Action verb is greater than PO7 verb. Therefore, the correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0302	Mechanics of Solids	3	0	0	3

Course Outcomes:

CO: 1 Apply the concepts of stresses-strains to various machine elements.
CO: 2 Analyze Shear Force and Bending Moment in the beam subjected to different loading conditions.
CO: 3 Evaluate shear stresses and bending stresses in a beam subjected to different loading conditions.
CO: 4 Analyze the deflections of beams and torsional stresses subjected to different loading conditions.
CO: 5 Evaluate the buckling loads for columns and stresses in thin and thick cylinders subjected to pressure.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the concepts of stresses-strains		to various machine elements	L3
CO2	Analyze	Shear Force and Bending Moment in the beam subjected to different loading conditions.			L4
CO3	Evaluate	shear stresses and bending stresses in a beam subjected to different loading conditions.			L5
CO4	Analyze	the deflections of beams and torsional stresses subjected to different loading conditions.			L4
CO5	Evaluate	the buckling loads for columns and stresses in thin and thick cylinders subjected to pressure.			L5

Unit I:

SIMPLE STRESSES & STRAINS : Elasticity and plasticity – Types of stresses & strains–Hooke's law – stress – strain diagram for mild steel – Working stress – Factor of safety – Lateral strain, Poisson's ratio & volumetric strain – Bars of varying section – composite bars – Temperature stresses- Complex Stresses - Stresses on an inclined plane under different uniaxial and biaxial stress conditions - Principal planes and principal stresses - Mohr's circle - Relation between elastic constants, Strain energy – Resilience – Gradual, sudden, impact and shock loadings.

Unit II

SHEAR FORCE AND BENDING MOMENT: Definition of beam – Types of beams – Concept of shear force and bending moment – S.F and B.M diagrams for cantilever, simply supported and overhanging beams subjected to point loads, u.d.l, uniformly varying loads and combination of these loads – Point of contra flexure – Relation between S.F., B.M and rate of loading at a section of a beam.

Unit III

FLEXURAL STRESSES: Theory of simple bending, Derivation of bending equation, Determination of bending stresses – section modulus of rectangular, circular, I and T sections– Design of simple beam sections. SHEAR STRESSES: Derivation of formula – Shear stress distribution across various beams sections like rectangular, circular, triangular, I and T sections.

Unit IV

DEFLECTION OF BEAMS: Bending into a circular arc – slope, deflection and radius of curvature – Differential equation for the elastic line of a beam – Double integration and Macaulay's methods – Determination of slope and deflection for cantilever and simply supported beams subjected to point loads, UDL and UVL. Mohr's theorem and Moment area method – application to simple cases.

TORSION: Introduction-Derivation- Torsion of Circular shafts- Pure Shear-Transmission of power by circular shafts, Shafts in series, Shafts in parallel.

Unit V

THIN AND THICK CYLINDERS: Thin seamless cylindrical shells – Derivation of formula for longitudinal and circumferential stresses – hoop, longitudinal and volumetric strains – changes in dia, and volume of thin cylinders– Thin spherical shells. Wire wound thin cylinders. Lame's equation – cylinders subjected to inside & outside pressures – compound cylinders.

COLUMNS: Buckling and Stability, Columns with Pinned ends, Columns with other support Conditions, Limitations of Euler's Formula, Rankine's Formula.

Text Books:

1. GH Ryder, Strength of materials, Palgrave Macmillan publishers India Ltd, 1961.
2. B.C. Punmia, Strength of materials,10/e, Lakshmi publications Pvt. Ltd, New Delhi, 2018.

Reference Books:

1. Gere &Timoshenko, Mechanics of materials, 2/e, CBS publications, 2004.
2. U.C. Jindal, Strength of Materials, 2/e, Pearson Education, 2017.
3. Timoshenko, Strength of Materials Part – I& II, 3/e, CBS Publishers, 2004.
4. Andrew Pytel and Ferdinand L. Singer, Strength of Materials,4/e, Longman Publications, 1990.
5. Popov, Mechanics of Solids, 2/e, New Pearson Education, 2015.

Online Learning Resources:

- https://onlinecourses.nptel.ac.in/noc19_ce18/preview.
- https://youtube/iY_ypychVNY?si=310htc4ksTQJ8Fv6.
- https://www.youtube.com/watch?v=WEy939Rkd_M&t=2s
- https://www.classcentral.com/course/swayam-strength-of-materials-iitm-184204
- https://www.coursera.org/learn/mechanics-1
- https://www.edx.org/learn/engineering/massachusetts-institute-of-technology-mechanical-behavior-of-materials-part-1-linear-elastic-behavior
- https://archive.nptel.ac.in/courses/112/107/112107146/

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Mechanics of Solids	CO1	3	3	3									3	3
	CO2	3	3	3									3	3
	CO3	3	3	3									3	3
	CO4	3	3	3									3	3
	CO5	3	3	3									3	3

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

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MECHANICAL ENGINEERING (ME)

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	18	21.5	3	Apply	L3	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
2	18	21.5	3	Analyze	L4	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
3	16	19	2	Evaluate	L5	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
4	16	19	2	Analyze	L4	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
5	16	19	2	Evaluate	L5	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
	84	100						

Justification Statements:

CO1: Apply the concepts of stresses-strains to various machine elements.
Action Verb: Apply (L3)
PO1Verb: **Apply (L3)**
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO1 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

CO2: Analyze Shear Force and Bending Moment in the beam subjected to different loading conditions.
Action Verb: Analyze (L4)
PO1Verb: **Apply (L3)**
CO2 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO2 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

CO3: Evaluate shear stresses and bending stresses in a beam subjected to different loading conditions.
Action Verb: Evaluate (L5)
PO1Verb: **Apply (L3)**
CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO3 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO3 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

CO4: Analyze the deflections of beams and torsional stresses subjected to different loading conditions.
Action Verb: Analyze (L4)
PO1Verb: **Apply (L3)**

CO4 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO4 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

CO5: Evaluate the buckling loads for columns and stresses in thin and thick cylinders subjected to pressure.
Action Verb: Evaluate (L5)
PO1Verb: **Apply (L3)**
CO5 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO5 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO5 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0303	Material Science and Metallurgy	3	0	0	3

Course Outcomes:

CO: 1 Understand the crystalline structure of different metals and stability ofphases in different alloy systems.
CO: 2 Understand the behavior of ferrous and nonferrous metals and alloys.
CO: 3 Analyze the effect of heat treatment, addition of alloying elements and TTT Diagrams.
CO: 4 Apply the process of metal powders and applications of powder metallurgy in manufacturing methods.
CO: 5 Analyze the properties and applications of ceramic, composites, nano and smart materials.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the crystalline structure of different metals and stability of phases in different alloy systems			L2
CO2	Understand	the behavior of ferrous and nonferrous metals and alloys			L2
CO3	Analyze	the effect of heat treatment, addition of alloying elements and TTT Diagrams			L4
CO4	Apply	the process of metal powders and applications of powder metallurgy		in manufacturing methods.	L3
CO5	Analyze	the properties and applications of ceramic, composites nano and smart materials			L4

Unit I:

Structure of Metals and Constitution of alloys: Crystallization of metals, Packing Factor - SC, BCC, FCC& HCP line density, plane density. Grain and grain boundaries, effect of grain boundaries determination of grainsize. Imperfections, Slip and Twinning. Necessity of alloying, types of solid solutions, Hume-Rothery's rules, intermediate alloy phases, and electron compounds.

Equilibrium Diagrams: Experimental methods of construction of equilibrium diagrams, Isomorphous alloy systems, equilibrium cooling and heating of alloys, Lever rule, coring miscibility gaps, eutectic systems, congruent melting intermediate phases, peritectic reaction. Transformations in the solid state – allotropy, eutectoid, peritectoid reactions, phase rule, relationship between equilibrium diagrams and properties of alloys. Study of binary phase diagrams such as Cu-Ni and Fe-Fe3C.

Unit II

Ferrous metals and alloys: Structure and properties of White Cast iron, Malleable Cast iron, grey cast iron, Spheroidal graphite cast iron, Alloy cast iron. Classification of steels, structure and properties of plain carbon steels, Low alloy steels, Hadfield manganese steels, tool and die steels.

Non-ferrous Metals and Alloys: Structure and properties of copper and its alloys, Aluminum and its alloys, Titanium and its alloys, Magnesium and its alloys, Super alloys.

Unit III

Heat treatment of Steels: Effect of alloying elements on Fe-Fe_3C system, annealing, normalizing, hardening, TTT diagrams, tempering, hardenability, surface - hardening methods, age hardening treatment, Cryogenic treatment.

Unit IV

Powder Metallurgy: Basic processes- Methods of producing metal powders- milling atomization-Granulation-Reduction-Electrolytic Deposition. Compacting methods – Sintering - Methods of manufacturing sintered parts. Secondary operations, Applications of powder metallurgical products.

Unit V

Ceramic and Advanced materials: Crystalline ceramics, glasses, cermets, abrasive materials, Classification of composites, manufacturing methods, particle reinforced composites, fiber reinforced composites, PMC, MMC, CMC and CCCs. Introduction to Nanomaterials and smart materials.

Text Books:

1. S.H.Avner, Introduction to Physical Metallurgy, 2/e, Tata McGraw- Hill, 1997.
2. Donald R. Askeland, Essentials of Materials science and Engineering, 4/e, CL Engineering publications, 2018.

Reference Books:

1. Dr. V.D. Kodgire, Material Science and Metallurgy, 39/e, Everest Publishing House, 2017.
2. V. Raghavan, Material Science and Engineering, 5/e, Prentice Hall of India, 2004.
3. William D. Callister Jr, Materials Science and Engineering: An Introduction, 8/e, John Wiley and Sons, 2009.
4. George E. Dieter, Mechanical Metallurgy, 3/e, McGraw-Hill, 2013.
5. Yip-Wah Chung, Introduction to Material Science and Engineering, 2/e, CRC Press, 2022.
6. A V K Suryanarayana, Material Science and Metallurgy, B S Publications, 2014.
7. U. C. Jindal, Material Science and Metallurgy, 1/e, Pearson Publications, 2011.

Online Learning Resources:

- https://archive.nptel.ac.in/courses/113/106/113106032/
- https://www.edx.org/learn/mechanics/massachusetts-institute-of-technology-mechanical-behavior-of-materials-part-3-time-dependent-behavior.
- https://www.youtube.com/watch?v=9Sf278j1GTU
- https://www.coursera.org/learn/fundamentals-of-materials-science
- https://www.coursera.org/learn/material-behavior.

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Material Science and Metallurgy	CO1	2	2				2						2	2
	CO2	2	2				2						2	2
	CO3	3	3				3						3	3
	CO4	3	3				3						3	3
	CO5	3	3				3						3	3

CO	CO					Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Lesson Plan (Hrs)	%	Correlation	Verb	BTL			
1	19	29	3	Understand	L2	PO1 PO2 PO6	Identify-L3 Review-L2 Thumb Rule	2 3 2

2	**15**	**23**	**3**	Understand	L2	**PO1 PO2 PO6**	**Identify-L3 Review-L2 Thumb Rule**	**2 3 2**
3	**8**	**12**	**1**	Analyze	L4	**PO1 PO2 PO6**	**Apply-L3 Review-L2 Thumb Rule**	**3 3 3**
4	**10**	**15**	**2**	Apply	L3	**PO1 PO2 PO6**	**Apply-L3 Review-L2 Thumb Rule**	**3 3 3**
5	**12**	**18**	**2**	Analyze	L4	**PO1 PO2 PO6**	**Applyy-L3 Review-L2 Thumb Rule**	**3 3 3**

Justification Statements:

CO1: Understand the crystalline structure of different metals and stability ofphases in different alloy systems

Action Verb: **Understand** (L2)

PO1 Verb: **Identify (L3)**

CO1 Action verb is less than as PO1 verb. Therefore, the correlation is medium (2)

PO2 Verb: **Review (L2)**

CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO6 Verb: **Thumb rule**

CO1 Action verb is less than as PO6 verb. Therefore, the correlation is medium (2)

CO2: Understand the behavior of ferrous and nonferrous metals and alloys

Action Verb: **Understand** (L2)

PO1 Verb: **Identify (L3)**

CO2 Action verb is less than as PO1 verb. Therefore, the correlation is medium (2)

PO2 Verb: **Review (L2)**

CO2 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO6 Verb: **Thumb rule**

CO2 Action verb is less than as PO6 verb. Therefore, the correlation is medium (2)

CO3: Analyze the effect of heat treatment, addition of alloying elements and TTT Diagrams

Action Verb: **Analyse** (L4)

PO1 Verb: **Apply (L3)**

CO3 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Review (L2)**

CO3 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO6 Verb: **Thumb rule**

CO3 Action verb is same level (greater) as PO6 verb. Therefore, the correlation is high (3)

CO4: Apply the process of metal powders and applications of powder metallurgy in manufacturing methods

Action Verb: **Apply** (L3)

PO1 Verb: **Identify (L3)**

CO4 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Review (L2)**

CO4 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO6 Verb: **Thumb rule**

CO4 Action verb is same level as PO6 verb. Therefore, the correlation is high (3)

CO5: Analyze the properties and applications of ceramic, composites, Nano and smart materials

Action Verb: **Analyze (L4)**
PO1 Verb: **Apply (L3)**
CO5 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Review (L2)**
CO5 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO6 Verb: **Thumb rule**
CO5 Action verb is same level (greater) as PO6 verb. Therefore, the correlation is high (3)

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Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0304	Mechanics of Solids and Materials Science Lab	0	0	3	1.5

Course Outcomes:

CO: 1 Evaluate the tensile, hardness, impact, bending, shear and torsional properties of materials.
CO: 2 Evaluate the stiffness and tension on springs.
CO: 3 Analyze the surface defects like cracks and porosity on metals using liquid penetration test.
CO: 4 Understand the various microstructures of metals, steels and cast irons.
CO: 5 Understand the various microstructures of nonferrous alloys and heat-treated steels.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Evaluate	the tensile, hardness, impact, bending, shear and torsional properties of materials			L5
CO2	Evaluate	the stiffness and tension on springs			L4
CO3	Analyze	the surface defects like cracks and porosity	on metals using liquid penetration test		L5
CO4	Understand	the various microstructures of metals, steels and cast irons			L2
CO5	Understand	the various microstructures of nonferrous alloys and heat-treated steels.			L2
CO6	Analyze	the Hardenability of steels	by using Jominy End Quench Test		L4

NOTE: Any 6 experiments from each section A and B.

A) MECHANICS OF SOLIDS LAB:

1. Tensile test
2. Bending test on
   a) Simply supported beam
   b) Cantilever beam
3. Torsion test
4. Hardness test
   a) Brinell's hardness test
   b) Rockwell hardness test
   c) Vickers hardness test
5. Test on springs
6. Impact test
   a) Charpy test
   b) Izod test
7. Punch shear test
8. Liquid penetration test

B) MATERIAL SCIENCE LAB:

1. Preparation and study of the Microstructure of pure metals.
2. Preparation and study of the Microstructure of Mild steel, medium carbon steels, and High carbon steels.
3. Study of the Microstructures of Cast Irons.
4. Study of the Microstructures of Non-Ferrous alloys.
5. Study of the Microstructures of Heat-treated steels.
6. Hardenability of steels by Jominy End Quench Test

Virtual lab:

1. To investigate the principal stresses σa and σb at any given point of a structural element or machine component when it is in a state of plane stress. (https://virtual-labs.github.io/exp-rockwell-hardness-experiment-iiith/objective.html)
2. To find the impact resistance of mild steel and cast iron.(https://sm-nitk.vlabs.ac.in/exp/izod-impact-test).
3. To find the impact resistance of mild steel.(https://sm-nitk.vlabs.ac.in/exp/charpy-impact-test/index.html)
4. To find the Rockwell hardness number of mild steel, cast iron, brass, aluminum and spring steel etc. (https://sm-nitk.vlabs.ac.in/exp/rockwell-hardness-test)
5. To determine the indentation hardness of mild steel, brass, aluminum etc. using Vickers hardness testing machine. (https://sm-nitk.vlabs.ac.in/exp/vickers-hardness-test).

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Mechanics of Solids and Materials Science Lab	CO1	3	3							3			3	3
	CO2	3	3							3			3	3
	CO3	3	3							3			3	3
	CO4	2	2							2			2	2
	CO5	2	2							2			2	2
	CO6	3	3							3			3	3

CO	Cos		Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Verb	BTL			
1	Evaluate	L5	PO1 PO2 PO9	Apply (L3) Identify (L3) Thumb Rule	3 3 3
2	Evaluate	L5	PO1 PO2 PO9	Apply (L3) Identify (L3) Thumb Rule	3 3 3
3	Analyze	L4	PO1 PO2 PO9	Apply (L3) Identify (L3) Thumb Rule	3 3 3
4	Understand	L2	PO1 PO2 PO9	Apply (L3) Identify (L3) Thumb Rule	2 2 3
5	Understand	L2	PO1 PO2 PO9	Apply (L3) Identify (L3) Thumb Rule	2 2 3

6	**Analyze**	L4	PO1 PO2 PO9	Apply (L3) Identify (L3) Thumb Rule	3 3 3

Justification Statements:

CO1: Evaluate the tensile, hardness, impact, bending, shear and torsional properties of materials
Action Verb: **Evaluate** (L5)
PO1 Verb: **Applyy (L3)**
CO1 Action verb is same level (greater) than as PO1 verb. Therefore, the correlation is medium (2)
PO2 Verb: **Identify (L3)**
CO1 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb rule**
CO1 Action verb is same level (greater) than as PO9 verb. Therefore, the correlation is high (3)

CO2: Evaluate the stiffness and tension on springs
Action Verb: **Evaluate** (L5)
PO1 Verb: **Applyy (L3)**
CO2 Action verb is same level (greater) than as PO1 verb. Therefore, the correlation is medium (2)
PO2 Verb: **Identify (L3)**
CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb rule**
CO2 Action verb is same level (greater) than as PO9 verb. Therefore, the correlation is high (3)

CO3: Analyze the surface defects like cracks and porosity on metals using liquid penetration test s
Action Verb: **Analyse** (L4)
PO1 Verb: **Applyy (L3)**
CO3 Action verb is same level (greater) than as PO1 verb. Therefore, the correlation is medium (2)
PO2 Verb: **Identify (L3)**
CO3 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb rule**
CO3 Action verb is same level (greater) than as PO9 verb. Therefore, the correlation is high (3)

CO4: Understand the various microstructures of metals, steels and cast irons
Action Verb: **Apply** (L3)
PO1 Verb: **Apply (L3)**
CO4 Action verb is less than as PO1 verb. Therefore, the correlation is medium (2)
PO2 Verb: **Identify (L3)**
CO4 Action verb is less than as PO2 verb. Therefore, the correlation is medium (2)
PO6 Verb: **Thumb rule**
CO4 Action verb is same level as PO6 verb. Therefore, the correlation is high (3)

CO5: Understand the various microstructures of nonferrous alloys and heat treated steels
PO1 Verb: **Apply (L3)**
CO5 Action verb is less than as PO1 verb. Therefore, the correlation is medium (2)
PO2 Verb: **Identify (L3)**

CO5 Action verb is less than as PO2 verb. Therefore, the correlation is medium (2)
PO6 Verb: **Thumb rule**
CO5 Action verb is same level as PO6 verb. Therefore, the correlation is high (3)

CO6: Analyz**e** the Hardenability of steels by using Jominy End Quench Test
Action Verb: **Analyse** (L4)
PO1 Verb: **Apply (L3)**
CO6 Action verb is same level (greater) than as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO6 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO9 Verb: **Thumb rule**
CO6 Action verb is same level (greater) than as PO9 verb. Therefore, the correlation is high (3)

ANNAMACHARYA INSTITUTE OF TECHNOLOGY AND SCIENCES, TIRUPATI
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Course structure for Four Year Regular B.Tech. Degree Program
(Effective for the batches admitted from 2023-24)
MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0305	Computer-Aided Machine Drawing	0	0	3	1.5

Course Outcomes:

CO: 1 Understand the concepts of conventional representations of materials and machine components.
CO: 2 Apply the drawing skills to design (build/develop) the machine elements and simple components.
CO: 3 Create solid models and sectional views of machine components.
CO: 4 Analyze the assembly views for the part drawing of the machine and engine parts.
CO: 5 Understand the representation of limits, fits and tolerances for mating parts.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concepts of conventional representations of materials and machine components			L2
CO2	Apply	the drawing skills to design (build / develop) the machine elements and simple components			L3
CO3	Create	solid models and sectional views of machine components			L6
CO4	Analyze	the assembly views for the part drawing of the machine and engine parts			L4
CO5	Understand	the representation of limits, fits and tolerances for mating parts			L2

The following are to be done by any 2D software package
Conventional representation of materials and components:

Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts,bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.

Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted, doubleriveted double strap joints.

Welded joints: Lap joint and T joint with fillet, butt joint with conventions.

Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.

Couplings: rigid – Muff, flange; flexible – bushed pin-type flange coupling, universalcoupling, Oldham's coupling.

The following exercises are to be done by any 3D software package:

Sectional views:
Creating solid models of complex machine parts and sectional views.

Assembly drawings: (Any four of the following using solid model software)
Lathe tool post, tool head of shaping machine, tail-stock, machine vice, gate valve, carburetor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling.

Production drawing:

Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances

Text Books:

1. Machine Drawing by K.L. Narayana, P. Kannaiah and K.Venkat Reddy, New Age International Publishers, 3/e, 2014
2. Machine drawing by N. Sideshwar, P. Kannaiah, V.V.S. Sastry, TMH Publishers. 2014

Reference Books:

1. Cecil Jensen, Jay Helsel and Donald D. Voisinet, Computer Aided Engineering Drawing, Tata McGraw-Hill, NY, 2000.
2. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2003.
3. N.D. Bhatt, Machine Drawing, Charotar Publishers, 50/e, 2014.

Online Learning Resources:

- https://eeedocs.wordpress.com/wp-content/uploads/2014/02/machinedrawing.pdf
- https://archive.nptel.ac.in/courses/112/105/112105294/
- https://www.edx.org/learn/engineering/dassault-systemes-solidworks-solidworks-cad-fundamentals?index=product&queryID=c90b35a82a6ef58b0d6f89679c63f6a1&position=2&linked_from=autocomplete&c=autocomplete
- https://www.youtube.com/watch?v=0bQkS3_3Fq4

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Computer Aided Machine Drawing	CO1	3		2		3				2			2	2
	CO2	3		2		3				2			2	2
	CO3	3		2		3				2			2	2
	CO4	3		2		3				2			2	2
	CO5	3		2		3				2			2	2

Correlation matrix

CO	Cos		Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
	Verb	BTL			
1	Understand	L2	PO1 PO3 PO5 PO9	Apply (L3) Develop (L3) Apply (L3) Thumb Rule	2 2 2 3
2	Apply	L3	PO1 PO3 PO5 PO9	Apply (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3
3	Create	L6	PO1 PO3 PO5 PO9	Apply (L3) Develop (L3) Create (L6) Thumb Rule	3 3 3 3
4	Analyze	L4	PO1 PO3 PO5 PO9	Apply (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3

5	Understand	L2	PO1 PO3 PO5 PO9	Apply (L3) Develop (L3) Apply (L3) Thumb Rule	2 2 2 3

Justification Statements:

CO1: Understand the concepts of conventional representations of materials and machine components.
Action Verb: Understand (L2)
PO1Verb: **Apply (L3)**
CO1 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO3 Verb: **Develop (L3)**
CO1 Action verb is less than PO3 verb by one level. Therefore, the correlation is medium (2)
PO5 Verb: **Apply (L3)**
CO1 Action verb is less than PO5 verb by one level. Therefore, the correlation is medium (2)
CO1: Computer-Aided Machine Drawing involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3).

CO2: Apply the drawing skills to design (build/develop) the machine elements and simple components.
Action Verb: Apply (L3)
PO1Verb: **Apply (L3)**
CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO2 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO2 Action verb is same level as PO5 verb. Therefore, the correlation is high (3)
CO2: Computer-Aided Machine Drawing involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3).

CO3: Create solid models and sectional views of machine components.
Action Verb: Create (L6)
PO1Verb: **Apply (L3)**
CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO3 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Create (L6)**
CO3 Action verb is same level as PO5 verb. Therefore, the correlation is high (3)
CO3: Computer-Aided Machine Drawing involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3).

CO4: Analyze the assembly views for the part drawing of the machine and engine parts.
Action Verb: **Analyze (L4)**
PO1Verb: **Apply (L3)**
CO4 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO4 Action verb is same level as PO5 verb. Therefore, the correlation is high (3)
CO4: Computer-Aided Machine Drawing involves creating visual representations and technical

drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3).

CO5: Understand the representation of limits, fits and tolerances for mating parts.
Action Verb: Understand (L2)
PO1Verb: **Apply (L3)**
CO5 Action verb is less than PO1 verb by one level. Therefore, the correlation is medium (2)
PO3 Verb: **Develop (L3)**
CO5 Action verb is less than PO3 verb by one level. Therefore, the correlation is medium (2)
PO5 Verb: **Apply (L3)**
CO5 Action verb is less than PO5 verb by one level. Therefore, the correlation is medium (2)
CO5: Computer-Aided Machine Drawing involves creating visual representations and technical drawings to communicate design ideas, concepts and specifications. Therefore, the correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AES0402	Embedded Systems & IoT	0	0	2	1

Course Outcomes:

CO: 1 Analyze the measurement of analog signals from Sensors using ADC and PWM
CO: 2 Design Full duplex communication links using hyper terminal for reliable data exchange.
CO: 3 Analyze the control of Actuators using analog GPIOs on Arduino platforms.
CO: 4 Understand the use of IDEs like Arduino IDE and Python based IDEs for Raspberry pi to trace and debug code.
CO: 5 Analyze IoT solutions by interfacing with online services and public APIs for data acquisition.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concepts of conventional representations of materials and machine components			L2
CO2	Apply	the drawing skills to design (build / develop) the machine elements and simple components			L3
CO3	Create	solid models and sectional views of machine components			L6
CO4	Analyze	the assembly views for the part drawing of the machine and engine parts			L4
CO5	Understand	the representation of limits, fits and tolerances for mating parts			L2

The following are to be done by any 2D software package
Conventional representation of materials and components:

Detachable joints: Drawing of thread profiles, hexagonal and square-headed bolts and nuts,bolted joint with washer and locknut, stud joint, screw joint and foundation bolts.

Riveted joints: Drawing of rivet, lap joint, butt joint with single strap, single riveted, doubleriveted double strap joints.

Welded joints: Lap joint and T joint with fillet, butt joint with conventions.

Keys: Taper key, sunk taper key, round key, saddle key, feather key, woodruff key.

Couplings: rigid – Muff, flange; flexible – bushed pin-type flange coupling, universalcoupling, Oldham's coupling.

The following exercises are to be done by any 3D software package:

Sectional views:
Creating solid models of complex machine parts and sectional views.

Assembly drawings: (Any four of the following using solid model software)
Lathe tool post, tool head of shaping machine, tail-stock, machine vice, gate valve, carburetor, piston, connecting rod, eccentric, screw jack, plumber block, axle bearing, pipe vice, clamping device, Geneva cam, universal coupling.

Production drawing:

Representation of limits, fits and tolerances for mating parts. Use any four parts of above assembly drawings and prepare manufacturing drawing with dimensional and geometric tolerances

Text Books:

1. Machine Drawing by K.L. Narayana, P. Kannaiah and K.Venkat Reddy, New Age International Publishers, 3/e, 2014
2. Machine drawing by N. Sideshwar, P. Kannaiah, V.V.S. Sastry, TMH Publishers. 2014

Reference Books:

1. Cecil Jensen, Jay Helsel and Donald D. Voisinet, Computer Aided Engineering Drawing, Tata McGraw-Hill, NY, 2000.
2. James Barclay, Brain Griffiths, Engineering Drawing for Manufacture, Kogan Page Science, 2003.
3. N.D. Bhatt, Machine Drawing, Charotar Publishers, 50/e, 2014.

Online Learning Resources:

- https://eeedocs.wordpress.com/wp-content/uploads/2014/02/machinedrawing.pdf
- https://archive.nptel.ac.in/courses/112/105/112105294/
- https://www.edx.org/learn/engineering/dassault-systemes-solidworks-solidworks-cad-fundamentals?index=product&queryID=c90b35a82a6ef58b0d6f89679c63f6a1&position=2&linked_from=autocomplete&c=autocomplete
- https://www.youtube.com/watch?v=0bQkS3_3Fq4

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Computer Aided Machine Drawing	CO1	3		2		3				2			2	2
	CO2	3		2		3				2			2	2
	CO3	3		2		3				2			2	2
	CO4	3		2		3				2			2	2
	CO5	3		2		3				2			2	2

Correlation matrix

S.No	Course Outcomes(CO)		Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Co's Action verb	BTL			
1	Analyze	L4	PO1, PO2, PO3, PO4, PO5	PO1: Apply (L3) PO2:Identify(L3) PO3: Develop (L3) PO4:Analyze(L4) PO5:Apply(L3)	3 3 3 3 3
2	Design	L3	PO1, PO3, PO4, PO5	PO1: Apply (L3) PO3: Develop (L3) PO4:Analyze(L4) PO5:Apply(L3)	3 3 2 3
3	Analyze	L4	PO1, PO2, PO3, PO4, PO5	PO1: Apply (L3) PO2:Identify(L3) PO3: Develop (L3) PO4:Interpret(L5) PO5:Apply(L3)	3 3 3 2 3
4	Understand	L2	PO1, PO3, PO5	PO1: Apply (L3) PO3: Develop (L3) PO5:Apply(L3)	2 2 2
5	Analyze	L4	PO1, PO3, PO4, PO5	PO1: Apply (L3) PO3: Develop (L3) PO4:Analyze(L4) PO5:Apply(L3)	3 3 3 3

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MECHANICAL ENGINEERING (ME)

JUSTIFICATION STATEMENTS

CO1: Analyze the measurement of analog signals from Sensors using ADC and PWM
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO1 Action Verb is greater than PO1 verb by one level; Therefore, correlation is high (3).
PO2 Verbs: Identify (L3)
CO1 Action Verb is greater than PO2 verb by one level; Therefore, correlation is high (3).
PO3 Verbs: Develop (L3)
CO1 Action Verb is greater than PO3 verb by one level; Therefore correlation is high (3).
PO4 Verbs: Analyze (L4)
CO1 Action Verb is equal to PO4 verb; Therefore correlation is high (3).
PO5 Verbs: Apply (L3)
CO1 Action Verb is greater than PO5 verb by one level; Therefore, correlation is high (3).

CO2: Design Full duplex communication links using hyper terminal for reliable data exchange.
Action Verb: Design (L3)
PO1 Verbs: Apply (L3)
CO2 Action Verb is equal to PO1 verb ; Therefore, correlation is high (3).
PO3 Verbs: Develop (L3)
CO2 Action Verb is equal to PO3 verb ; Therefore, correlation is high (3).
PO4 Verbs: Analyze (L4)
CO2 Action Verb is less than PO4 verb by one level; Therefore correlation is moderate (2).
PO5 Verbs: Apply (L3)
CO2 Action Verb is equal to PO5 verb ; Therefore, correlation is high (3).

CO3: Analyze the control of Actuators using analog GPIOs on Arduino platforms.
Action Verb: Analyze (L4)

PO1 Verbs: Apply (L3)
CO3 Action Verb is equal to PO1 verb ; Therefore, correlation is high (3).
PO2 Verbs: Identify (L3)
CO3 Action Verb is equal to PO2 verb ; Therefore, correlation is high (3).
PO3 Verbs: Develop (L3)
CO3 Action Verb is equal to PO3 verb ; Therefore, correlation is high (3).
PO4 Verbs: Interpret (L5)
CO2 Action Verb is less thanPO4 verb by one level; Therefore correlation is moderate (2).
PO5 Verbs: Apply (L3)
CO3 Action Verb is equal to PO5 verb ; Therefore, correlation is high (3).

CO4: Understand the use of IDEs like Arduino IDE and Python based IDEs for Raspberry pi to trace and debug code.
Action Verb: Understand (L2)
PO1 Verbs: Apply (L3)
CO4 Action Verb is less than PO1 verb by one level; Therefore, correlation is moderate (2).
PO3 Verbs: Develop (L3)
CO4 Action Verb is less than PO3 verb by one level; Therefore correlation is moderate (2).
PO5 Verbs: Apply (L3)
CO4 Action Verb is less than PO5 verb by one level; Therefore correlation is moderate (2).

CO5: Analyze IoT solutions by interfacing with online services and public APIs for data acquisition
Action Verb: Analyze (L4)
PO1 Verbs: Apply (L3)
CO5 Action Verb is equal to PO1 verb ; Therefore, correlation is high (3).
PO3 Verbs: Develop (L3)
CO5 Action Verb is equal to PO3 verb ; Therefore, correlation is high (3).
PO4 Verbs: Analyze (L4)
CO5 Action Verb is equal toPO4; Therefore correlation ishigh (3).
PO5 Verbs: Apply (L3)
CO5 Action Verb is equal to PO5 verb ; Therefore, correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: I** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23ASC0501	Python Programming	0	1	2	2

Course Outcomes:

CO: 1 Understand the Basic concepts of python programming to build scripts in IDLE.
CO: 2 Apply the modularity techniques to invoke user defined functions.
CO: 3 Apply the concept of Dictionaries, Tuples and sets to perform operations on data.
CO: 4 Analyze the file concepts and oops paradigms to manage data.
CO: 5 Apply the concepts of JSON and XML for data processing

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	**Understand**	Basic concepts of python programming		to build scripts in IDLE	L2
CO2	**Apply**	the modularity techniques		to invoke user defined functions	L3
CO3	**Apply**	the concept of Dictionaries, Tuples and sets		to perform operations on data.	L3
CO4	**Analyze**	the file concepts and oops paradigms.		to manage data	L4
CO5	**Apply**	the concepts of JSON and XML		for data processing	L3

UNIT – I	9Hrs

History of Python Programming Language, Thrust Areas of Python, Installing Anaconda Python Distribution, Installing and Using Jupyter Notebook.
Parts of Python Programming Language: Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Indentation, Comments, Reading Input, Print Output, Type Conversions, the type () Function and Is Operator, Dynamic and Strongly Typed Language.
Control Flow Statements: if statement, if-else statement, if…elif…else, Nested if statement, while Loop, for Loop, continue and break Statements, Catching Exceptions Using try and except Statement.

Sample Experiments:

1. Write a program to find the largest element among three Numbers.
2. Write a Program to display all prime numbers within an interval
3. Write a program to swap two numbers without using a temporary variable.
4. Demonstrate the following Operators in Python with suitable examples.
   i) Arithmetic Operators ii) Relational Operators iii) Assignment Operators iv) Logical Operators v) Bit wise Operators vi) Ternary Operator vii) Membership Operators
   viii) Identity Operators
5. Write a program to add and multiply complex numbers
6. Write a program to print multiplication table of a given number.

UNIT – II	9 Hrs

Functions: Built-In Functions, Commonly Used Modules, Function Definition and Calling the function, return Statement and void Function, Scope and Lifetime of Variables, Default Parameters, Keyword Arguments, *args and **kwargs, Command

Line Arguments.

Strings: Creating and Storing Strings, Basic String Operations, Accessing Characters in String by Index Number, String Slicing and Joining, String Methods, Formatting Strings.

Lists: Creating Lists, Basic List Operations, Indexing and Slicing in Lists, Built-In Functions Used on Lists, List Methods, del Statement.

Sample Experiments:

7. Write a program to define a function with multiple return values.
8. Write a program to define a function using default arguments.
9. Write a program to find the length of the string without using any library functions.
10. Write a program to check if the substring is present in a given string or not.
11. Write a program to perform the given operations on a list:
    i.Addition ii. Insertion iii. slicing
12. Write a program to perform any 5 built-in functions by taking any list.

UNIT – III	9 Hrs

Dictionaries: Creating Dictionary, Accessing and Modifying key:value Pairs in Dictionaries, Built-In Functions Used on Dictionaries, Dictionary Methods, del Statement.

Tuples and Sets: Creating Tuples, Basic Tuple Operations, tuple() Function, Indexing and Slicing in Tuples, Built-In Functions Used on Tuples, Relation between Tuples and Lists, Relation between Tuples and Dictionaries, Using zip() Function, Sets, Set Methods, Frozenset.

Sample Experiments:

13. Write a program to create tuples (name, age, address, college) for at least two members and concatenate the tuples and print the concatenated tuples.
14. Write a program to count the number of vowels in a string (No control flow allowed).
15. Write a program to check if a given key exists in a dictionary or not.
16. Write a program to add a new key-value pair to an existing dictionary.
17. Write a program to sum all the items in a given dictionary.

UNIT – IV	9 Hrs

Files: Types of Files, Creating and Reading Text Data, File Methods to Read and Write Data, Reading and Writing Binary Files, Pickle Module, Reading and Writing CSV Files, Python os and os.path Modules.

Object-Oriented Programming: Classes and Objects, Creating Classes in Python, Creating Objects in Python, Constructor Method, Classes with Multiple Objects, Class Attributes Vs Data Attributes, Encapsulation, Inheritance, Polymorphism.

Sample Experiments:

18. Write a program to sort words in a file and put them in another file. The output file should have only lower-case words, so any upper-case words from source must be lowered.
19. Python program to print each line of a file in reverse order.
20. Python program to compute the number of characters, words and lines in a file.
21. Write a program to create, display, append, insert and reverse the order of the items in the array.
22. Write a program to add, transpose and multiply two matrices.
23. Write a Python program to create a class that represents a shape. Include methods to calculate its area and perimeter. Implement subclasses for different shapes like circle, triangle, and square.

UNIT – V	9Hrs

Introduction to Data Science: Functional Programming, JSON and XML in Python, NumPy with Python, Pandas.

Sample Experiments:

24. Python program to check whether a JSON string contains complex object or not.
25. Python Program to demonstrate NumPy arrays creation using array () function.
26. Python program to demonstrate use of ndim, shape, size, dtype.
27. Python program to demonstrate basic slicing, integer and Boolean indexing.
28. Python program to find min, max, sum, cumulative sum of array
29. Create a dictionary with at least five keys and each key represent value as a list where this list contains at least ten values and convert this dictionary as a pandas data frame and explore the data through the data frame as follows:
    a) Apply head () function to the pandas data frame
    b) Perform various data selection operations on Data Frame
30. Select any two columns from the above data frame, and observe the change in one attribute with respect to other attribute with scatter and plot operations in matplotlib

Reference Books:

1. Gowrishankar S, Veena A., Introduction to Python Programming, CRC Press.
2. Python Programming, S Sridhar, J Indumathi, V M Hariharan, 2nd Edition, Pearson, 2024
3. Introduction to Programming Using Python, Y. Daniel Liang, Pearson.

Online Learning Resources/Virtual Labs

1. https://www.coursera.org/learn/python-for-applied-data-science-ai
2. https://www.coursera.org/learn/python?specialization=python#syllabus

Mapping of course outcomes with program outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
CO1	2	3	2		2							1	
CO2	3	3	3	2	3								2
CO3	3	3	3	2	3								2
CO4	3	3	3	3	3						2		
CO5	3	3	3	2	3								2

Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	9	20	2	CO1 : Understand	L2	PO1 PO2 PO3 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO5: Apply (L3)	2 3 2 2
2	9	20	2	CO2 : Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3 2 3
3	9	20	2	CO3 : Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3 2 3
4	9	20	2	CO4 : Analyze	L4	PO1 PO2 PO3 PO4 PO5 PO11	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply (L3) Thumb Rule	3 3 3 3 3 2

5	9	20	2	CO5 : Apply	L3	PO1 PO2 PO3 PO4 PO5	PO1: Apply(L3) PO2: Review(L2) PO3: Develop (L3) PO4: Analyze(L4) PO5: Apply (L3)	3 3 3 2 3
	53	100 %						

Justification Statements:

CO1: Understand the Basic concepts of python programming to build scripts in IDLE.

Action Verb : Understand(L2)

PO1 Verb : Apply(L3)

CO1 Action verb is less than PO1 verb by one level. Therefore the correlation is moderate (2)

PO2 Verb : Review(L2)

CO1 Action verb is same as PO2 verb. Therefore the correlation is high (3)

PO3 Verb : Develop(L3)

CO1 Action verb is less than PO3 verb by one level. Therefore the correlation is moderate (2)

PO5 Verb : Apply(L3)

CO1 Action verb is less than PO5 verb by one level. Therefore the correlation is moderate (2)

CO2: Apply the modularity techniques to invoke user defined functions**.**

Action Verb : Apply (L3)

PO1: Apply(L3)

CO2 Action verb is same as PO1 verb. Therefore the correlation is high (3)

PO2 Verb : Review(L2)

CO2 Action verb is greater than PO2 verb. Therefore the correlation high (3)

PO3 Verb : Develop (L3)

CO2 Action verb same as PO3 verb. Therefore the correlation high (3)

PO4 Verb : Analyze(L4)

CO2 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)

PO5 Verb : Apply(L3)

CO2 Action verb is same as PO5 verb. Therefore the correlation is high (3)

CO3: Apply the concept of Dictionaries, Tuples and sets to perform operations on data.

Action Verb : Apply(L3)

PO1: Apply(L3)

CO3 Action verb is same as PO1 verb. Therefore the correlation is high (3)

PO2 Verb : Review(L2)

CO3 Action verb is greater than PO2 verb. Therefore the correlation high (3)

PO3 Verb : Develop (L3)

CO3 Action verb same as PO3 verb. Therefore the correlation high (3)

PO4 Verb : Analyze(L4)

CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)

PO5 Verb : Apply(L3)

CO3 Action verb is same as PO5 verb. Therefore the correlation is high (3)

CO4: Analyze the file concepts and oops paradigms to manage data.

Action Verb: Analyze(L4)

PO1: Apply(L3)

CO3 Action verb is greater than PO1 verb. Therefore the correlation is high (3)

PO2 Verb : Review(L2)

CO3 Action verb is greater than PO2 verb. Therefore the correlation high (3)

PO3 Verb : Develop (L3)

CO3 Action verb is greater than PO3 verb. Therefore the correlation high (3)

PO4 Verb : Analyze(L4)

CO3 Action verb is same as PO4 verb. Therefore the correlation is high (3)

PO5 Verb : Apply(L3)

CO3 Action verb is greater than PO5 verb. Therefore the correlation is high (3)

PO11: Thumb rule

To solve the real time problems oops and file concepts are necessary for data security. Therefore the correlation is medium(2)

CO5: Apply the concepts of JSON and XML for data processing.

Action Verb : Apply(L3)

PO1: Apply(L3)

CO3 Action verb is same as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb : Review(L2)

CO3 Action verb is greater than PO2 verb. Therefore the correlation high (3)

PO3 Verb : Develop (L3)

CO3 Action verb same as PO3 verb. Therefore the correlation high (3)

PO4 Verb : Analyze(L4)

CO3 Action verb is less than PO4 verb by one level. Therefore the correlation is moderate (2)

PO5 Verb : Apply(L3)

CO3 Action verb is same as PO5 verb. Therefore the correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: II** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23AHM0301	Industrial Management	2	0	0	2

Course Outcomes:

CO: 1 Understand the managerial skills and make efficient facilities in an industry to support organizational goals and objectives
CO: 2 Apply the ergonomics in designing the work place to manage work processes more efficiently
CO: 3 Analyze the statistical data with relevant methods and tools to improve the quality in manufacturing (eg. ISO 9001) and focus on continuous improvement (eg. Six Sigma)
CO: 4 Apply the managerial skills to make financial decision, manage financial resources effectively and contribute to organizational success
CO: 5 Understand the strategic management to manage human capital, employee well-being effectively and apply knowledge of value analysis for creative problem-solving to achieve innovation

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the managerial skills and make efficient facilities in an industry to support organizational goals and objectives		in enterprise	L2
CO2	Apply	the ergonomics in designing the work place to manage work processes more efficiently		In manufacturing organization	L3
CO3	Analyze	Analyze the statistical data with relevant methods and tools to improve the quality in manufacturing (eg. ISO 9001) and focus on continuous improvement (eg. Six Sigma)		in quality inspection	L4
CO4	Apply	the managerial skills to make financial decision, manage financial resources effectively and contribute to organizational success		in manufacturing organization	L3
CO5	Understand	the strategic management to manage human capital, employee well-being effectively and apply knowledge of value analysis for creative problem-solving to achieve innovation		in manufacturing organization	L2

UNIT– I

INTRODUCTION: Definition of industrial engineering (I.E), development, applications, role of an industrial engineer, quantitative tools of IE and productivity measurement. Concepts of management, importance, function s of management, scientific management, Taylor's principles, Fayol's principles of management.

PLANT LAYOUT: Factors governing plant location, types of production layouts, advantages and dis-advantages of process layout and product layout, applications, quantitative techniques for optimal design of layouts.

UNIT–II

WORK STUDY: Importance, types of production, applications, work study, method study and time study, works sampling, PMTS, micro-motion study, rating techniques, MTM, work factor system, principles of Ergonomics, flow process charts, string diagrams and Therbligs.

UNIT–III

STATISTICAL QUALITY CONTROL: Quality control, Queuing assurance and its importance, SQC, attribute sampling inspection with single and double sampling, Control charts–X and R –charts X and Scharts

and their applications, simple numerical examples.

TOTAL QUALITY MANAGEMENT: Elements of TQM – Continuous Improvement – zero defect concept, quality circles, implementation, applications, ISO quality systems. Six Sigma– definition, basic concepts.

UNIT– IV

FINANCIAL MANAGEMENT: Scope and nature of financial management, Sources of finance, Management of working capital, estimation of working capital requirements, budget and budgetary control, Capital budgeting – Nature of Investment Decisions– Investment Evaluation criteria-NPV, IRR PI, Payback Period and ARR, numerical problems.

UNIT–V

HUMAN RESOURCE MANAGEMENT: Concept of human resource management, personnel management and industrial relations, functions of personnel management, Job- evaluation, its importance and types, merit rating, quantitative methods, wage incentive plans, and types.

VALUE ANALYSIS: Value engineering, implementation procedure, enterprise resource planning and supply chain management.

Text Books:

1. O. P Khanna, Industrial Engineering and Management, Dhanpat Rai Publications(P)Ltd.
2. Martand Telsang, Industrial Engineering and Production Management, S. Chand &Company Ltd. New Delhi

Reference Books:

1. Bhattacharya DK, Industrial Management, S. Chand, publishers.
2. J.G Monks, Operations Management, 3/e, McGraw Hill Publishers.
3. T.R. Banga, S.C. Sharma, N.K. Agarwal, Industrial Engineering and Management Science, Khanna Publishers.
4. Koontz O'Donnell, Principles of Management, McGraw Hill Publishers.
5. R.C. Gupta, Statistical Quality Control, Khanna Publishers.
6. NVS Raju, Industrial Engineering and Management, Cengage India Private Limited.

Online Learning Sources

- https://onlinecourses.nptel.ac.in/noc21_me15/preview
- https://onlinecourses.nptel.ac.in/noc20_mg43/preview
- https://www.edx.org/learn/industrial-engineering
- https://youtube.com/playlist?list=PL299B5CC87110A6E7&si=TghLCbEobuxjEaXi
- https://youtube.com/playlist?list=PLbjTnj-t5Gkl0z3OHOGK5RB9mvNYvnImW&si=oaX_5RG69hS3v2ll

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)											
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Industrial Management	CO1	3	3	2									2	2
	CO2	3	3	2									2	2
	CO3	3	3	2									2	2
	CO4	3	3	2									2	2
	CO5	3	3	2									2	2

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Correlation matrix

Unit No.	CO					Program Outcome (PO)	PO(s) :Action Verb and BTL(for PO1 to PO11)	Level of Correlation (0-3)
	Lesson plan(Hrs)	%	Correlation	Co's Action verb	BTL			
1	-	-	-	Understand	L2	PO1 PO3 PO5 PSO1 PSO2	Apply (L3) Develop (L3) Apply (L3) Thumb Rule Thumb Rule	2 2 2 2 2
2	-	-	-	Apply	L3	PO1 PO2 PSO1 PSO2	Apply (L3) Identify (L3) Thumb Rule Thumb Rule	3 3 3 2
3	-	-	-	Analyze	L4	PO1 PO4 PO5 PSO1 PSO2	Apply (L3) Analyse (L4) Apply (L3) Thumb Rule Thumb Rule	3 3 3 3 2
4	-	-	-	Apply	L3	PO1 PO2 PSO1 PSO2	Apply (L3) Identify (L3) Thumb Rule Thumb Rule	3 3 3 2
5	-	-	-	Understand	L2	PO1 PO2 PO4 PSO1 PSO2	Apply (L3) Identify (L3) Interpret (L2) Thumb Rule Thumb Rule	2 2 3 2 2

Justification Statements:

CO1: Understand the managerial skills and make efficient facilities in an industry to support organizational goals and objectives.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO1 Action verb is same (lower) level as PO1 verb. Therefore, the correlation is low (2).
PO3 Verb: Develop (L3)
CO1: Action verb is same (lower) level as PO3 verb. Therefore, the correlation is high (2).
PO5 Verb: Apply (L3)
CO1: Action verb is same (lower) level as PO5 verb. Therefore, the correlation is low (2).

CO2: Apply the ergonomics in designing the work place to manage work processes more efficiently.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO2: Action verb is same level as PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3)
CO2: Action verb is same level as PO2 verb. Therefore, the correlation is high (3).

CO3: Analyze the statistical data with relevant methods and tools to improve the quality in manufacturing (eg. ISO 9001) and focus on continuous improvement (eg. Six Sigma).
Action Verb: Analyze (L4)
PO1 Verb: Apply (L3)
CO3: Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3).
PO4 Verb: Analyze (L4)
CO3: Action verb is same level as PO4 verb. Therefore, the correlation is high (3).
PO5 Verb: Apply (L3)
CO3: Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3).

CO4: Apply the managerial skills to make financial decision, manage financial resources effectively and contribute to organizational success.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO4: Action verb is same level as PO1 verb. Therefore, the correlation is high (3).
PO2 Verb: Identify (L3)
CO4: Action verb is same level as PO2 verb. Therefore, the correlation is high (3).

CO5: Understand the strategic management to manage human capital, employee well-being effectively and apply knowledge of value analysis for creative problem-solving to achieve innovation.
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO5: Action verb is same (lower) level as PO1 verb. Therefore, the correlation is high (2).
PO2 Verb: Identify (L3)
CO5: Action verb is same (lower) level as as PO4 verb. Therefore, the correlation is high (2).
PO4 Verb: Interpret (L2)
CO5: Action verb is same level as PO4 verb. Therefore, the correlation is high (3).

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: II** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23ABS9914	Complex Variables, Probability and Statistics	3	0	0	3

Course Outcomes:

CO: 1 Apply the differentiation for complex variable functions.
CO: 2 Evaluate the integrals and power series expansions for complex variable functions
CO: 3 Understand the concepts of Probability theory and random variables
CO: 4 Apply various probability distributions to calculate their statistical constants.
CO: 5 Analyze the techniques for testing of hypothesis for large samples

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Apply	the differentiation	for complex variable functions		**L3**
2	Evaluate	the integrals and power series expansions	for complex variable functions		**L5**
3	Understand	the concepts of Probability theory and random variables			**L2**
4	Apply	Various probability distributions	to calculate their statistical constants		**L3**
5	Analyze	the techniques for testing of hypothesis	for large samples.		**L4**

UNIT I : Complex Variable – Differentiation **9 Hrs**

Introduction to functions of complex variable-concept of Limit, continuity & Differentiation, Cauchy-Riemann equations(Cartesian and polar coordinates), analytic functions, harmonic functions, finding harmonic conjugate-construction of analytic function by Milne Thomson method.

UNIT II: Complex Variable – Integration **10 Hrs**

Line integral-Contour integration, Cauchy's integral theorem(Simple Case), Cauchy Integral formula, Power series expansions: Taylor's series, zeros of analytic functions, singularities, Laurent's series, Residues, Cauchy Residue theorem (without proof), Evaluation of integrals of the type.

(a) $\int_0^{2\pi} F(cos\theta, sin\theta)\, d\theta$ (b) $\int_{-\infty}^{\infty} e^{imx}\, dx$

UNIT III: Probability theory & Random variables **9Hrs**

Probability, probability axioms, addition law and multiplicative law of probability, conditional probability, Baye's theorem, random variables (discrete and continuous), probability density functions, properties, mathematical expectation

UNIT IV: Probability Distributions **9Hrs**

Probability distributions - Binomial, Poisson approximation to the binomial distribution, Normal distribution and their properties

UNIT V: Estimation and Testing of hypothesis, large sample tests **9Hrs**

Estimation-parameters, statistics, sampling distribution, point estimation, Formulation of null hypothesis, alternative hypothesis, the critical and acceptance regions, level of significance, two types of errors and power of the test.

Large Sample Tests: Test for single proportion, difference of proportions, test for single mean and difference of means. Confidence interval for parameters in one sample and two sample problems

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Textbooks:

1. B.S.Grewal, Higher Engineering Mathematics, KhannaPublishers,2017, 44th Edition
2. Miller and Freunds, Probability and Statistics for Engineers, 7/e, Pearson, 2008.
3. R.K.JainandS.R.K.Iyengar,Advanced Engineering Mathematics, Alpha Science Internatio nal Ltd., 2021 5th Edition(9th reprint).

Reference Books:

1. B.V.Ramana, Higher Engineering Mathematics, Mc Graw Hill publishers 3. W. Feller, an Introduction to Probability Theory and its Applications, 1/e, Wiley, 1968.
2. S.Chand, Probability and Statistics by Dr.T.K.V.Iyengar, Dr.B.Krishna Gandhi, S.Ranganatham,Dr.M.V.S.S.N.Prasad.

Online Learning Resources:

1. https://onlinecourses.nptel.ac.in/noc20_ma50/preview
2. https://archive.nptel.ac.in/courses/111/106/111106111/

Mapping of COs to POs

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
1	3										
2		3									
3	2										
4	3										
5		3									

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Action Verb	BTL			
1				Apply	**L3**	PO1	**Apply(L3)**	3
2				Evaluate	**L5**	PO2	**Analyze (L4)**	3
3				Understand	**L2**	PO1	**Apply(L3)**	2
4				Apply	**L3**	PO1	**Apply (L3)**	3
5				Analyze	**L4**	PO2	**Analyze (L4)**	3

CO1: Apply the differentiation for complex variable functions.
Action Verb: Apply (L3)
PO1 Verb: Apply (L3)
CO1 Action Verb is equal to PO1 verb; Therefore correlation is high (3).
CO2: Evaluate the integrals and power series expansions for complex variable functions
Action Verb: Evaluate (L5)
PO2 Verb: Analyze (L4)
CO2 Action Verb is high level to PO2 verb; Therefore correlation is high (3).
CO3: Understand the concepts of Probability theory and random variables .
Action Verb: Understand (L2)
PO1 Verb: Apply (L3)
CO3 Action Verb is less than PO1 verb by one level; Therefore correlation is moderate(2).
CO4: Apply various probability distributions to calculate their statistical constants.
Action Verb: Apply (L3)
PO1 Verb: **Apply (L3)**
CO4 Action Verb level is equal to PO1 verb; Therefore correlation is high (3).

CO5: Analyze the techniques for testing of hypothesis for large samples.
Action Verb: Analyze(L4)

PO2 Verb: Analyze (L4)

CO5 Action verb is same level to PO2 verb; therefore the correlation is high (3).

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Year: II **Semester: II** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0306	Manufacturing processes	3	0	0	3

Course Outcomes:

CO: 1 Analyze the steps involved in fabrication of metal products
CO: 2 Understand the classification of welding methods used for joining metals
CO: 3 Apply the different categories of bulk forming techniques for fabrication of metals
CO: 4 Analyze the various sheet metal forming and high-energy rate forming processes for fabrication of metals
CO: 5 Analyze the different types of additive manufacturing processes for production of components

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the steps involved in fabrication of metal products			L4
CO2	Analyze	the classification of welding methods used		for joining metals	L4
CO3	Apply	the different categories of bulk forming techniques		for fabrication of metals	L3
CO4	Analyze	the various sheet metal forming and high-energy rate forming processes		for fabrication of metals	L4
CO5	Analyze	the different types of additive manufacturing processes		for production of components	L4

Unit I:

Casting: Steps involved in making a casting – Advantage of casting and its applications. Patterns and Pattern making – Types of patterns – Materials used for patterns, pattern allowances and their construction, Molding, different types of cores, Principles of Gating, Risers, casting design considerations. Methods of melting and types of furnaces, Solidification of castings and casting defects- causes and remedies. Basic principles and applications of special casting processes - Centrifugal casting, Die casting, Investment casting and shell molding.

Unit II

Welding: Classification of welding processes, types of welded joints and their characteristics, Gas welding, Different types of flames and uses, Oxy – Acetylene Gas cutting. Basic principles of Arc welding, power characteristics, Manual metal arc welding, submerged arc welding, TIG & MIG welding. Electro–slag welding. Resistance welding, Friction welding, Friction stir welding, Forge welding, Explosive welding; Thermit welding, Plasma Arc welding, Laser welding, electron beam welding, Soldering &Brazing. Heat affected zones in welding; pre & post heating, welding defects –causes and remedies.

Unit III

Bulk Forming: Plastic deformation in metals and alloys-recovery, recrystallization and grain growth. Hot working and Cold Working-Strain hardening and Annealing. Bulk forming processes: Forging-Types of Forging, forging defects and remedies; Rolling – fundamentals, types of rolling mills and products, Forces in rolling and power requirements. Extrusion and its characteristics. Types of extrusion, Impact extrusion, Hydrostatic extrusion; Wire drawing and Tube drawing.

Unit IV

Sheetmetal forming-Blanking and piercing, Forces and power requirement in these operations, Deep drawing, stretch forming, Bending, Spring back and its remedies, Coining, Spinning, Types of presses and press tools. High energy rate forming processes: Principles of explosive forming, electromagnetic forming, Electro hydraulic forming, rubber pad forming, advantages and limitations.

Unit V

Additive manufacturing - Steps in Additive Manufacturing (AM), Classification of AM processes, Advantages of AM, and types of materials for AM, VAT photopolymerization AM Processes, Extrusion - Based AM Processes, Powder Bed Fusion AM Processes, Direct Energy Deposition AM Processes, Post Processing of AM Parts, Applications.

Text Books:

1. Kalpak Jain S and Steven R Schmid, Manufacturing Processes for Engineering Materials, 5/e, Pearson Publications, 2007.
2. P.N. Rao, Manufacturing Technology -Vol I, 5/e, McGraw Hill Education, 2018

Reference Books:

1. A. Ghosh &A.K. Malik, Manufacturing Science, East West Press Pvt. Ltd, 2010.
2. Lindberg and Roy, Processes and materials of manufacture, 4/e, Prentice Hall India Learning Private Limited, 1990.
3. R.K. Jain, Production Technology, Khanna Publishers, 2022.
4. Sharma P.C., A Text book of Production Technology, 8/e, S Chand Publishing, 2014.
5. H.S. Shaun, Manufacturing Processes, 1/e, Pearson Publishers, 2012.
6. WAJ Chapman, Workshop Technology, 5/e, CBS Publishers & Distributors Pvt. Ltd, 2001.
7. Hindustan Machine Tools, Production Technology, Tata McGraw Hill Publishers, 2017.
8. Ian Gibson, David W Rosen, Brent Stucker., Additive Manufacturing Technologies: 3D Printing, Rapid Prototyping, and Direct Digital Manufacturing, 2/e, Springer, 2015.

Online Learning Resources:

- https://www.edx.org/learn/manufacturing/massachusetts-institute-of-technology-fundamentals-of-manufacturing-processes
- https://onlinecourses.nptel.ac.in/noc21_me81/preview
- www.coursera.org/learn/introduction-to-additive-manufacturing-processessera
- https://archive.nptel.ac.in/courses/112/103/112103263/
- https://elearn.nptel.ac.in/shop/nptel/principles-of-metal-forming-technology/?v=c86ee0d9d7ed

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Manufacturing Processes	CO1	3	3	3		3							3	3
	CO2	3	3	3		3							3	3
	CO3	3	3	3		3							3	3
	CO4	3	3	3		3							3	3
	CO5	3		3		3							3	3

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	13	20.3	L3	Analyze	L4	PO1 PO2 PO3 PO5	Apply (L3) Identify (L3) Develop (L3) Apply (L3)	3 3 3 3

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2	**13**	**20.3**	**L3**	**Analyze**	**L4**	PO1 PO2 PO3 PO5	Apply (L3) Identify (L3) Develop (L3) Apply (L3)	3 3 3 3
3	**13**	**20.3**	**L3**	**Apply**	**L3**	PO1 PO2 PO3 PO5	Apply (L3) Identify (L3) Develop (L3) Apply (L3)	3 3 3 3
4	**13**	**20.3**	**L3**	**Analyze**	**L4**	PO1 PO2 PO3 PO5	Apply (L3) Identify (L3) Develop (L3) Apply (L3)	3 3 3 3
5	**12**	**18.8**	**L2**	**Analyze**	**L4**	PO1 PO3 PO5	Apply (L3) Develop (L3) Apply (L3)	3 3 3
Total	**64**	**100**						

Justification Statements:

CO1: Analyze the steps involved in fabrication of metal products

Action Verb: Analyze (L4)

PO1 Verb: **Apply (L3)**

CO1 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO1 Action verb is same (greater) level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO1 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)

PO5 Verb: **Apply (L3)**

CO1 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)

CO2: Analyze the classification of welding methods used for joining metals

Action Verb: Analyze (L4)

PO1 Verb: **Apply (L3)**

CO2 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO2 Action verb is same (greater) level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO2 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)

PO5 Verb: **Apply (L3)**

CO2 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)

CO3: Apply the different categories of bulk forming techniques for fabrication of metals.

Action Verb: **Apply (L3)**

PO1 Verb: **Apply (L3)**

CO3 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO3 Action verb is same (greater) level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO3 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)

PO5 Verb: **Apply (L3)**

CO3 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)

CO4: Analyze the various sheet metal forming and high-energy rate forming processes for fabrication of metals

Action Verb: Analyze (L4)
PO1 Verb: **Apply (L3)**
CO4 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO4 Action verb is same (greater) level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO4 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)

CO5: Analyze the different types of additive manufacturing processes for production of components

Action Verb: Analyze (L4)
PO1 Verb: **Apply (L3)**
CO5 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO5 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO5 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)

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Year: II **Semester: II** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0307	Fluid Mechanics & Hydraulic Machines	3	0	0	3

Course Outcomes:

CO: 1 Understand the basic concepts of fluid properties.
CO: 2 Evaluate the mechanics of fluids in static and dynamic conditions.
CO: 3 Apply the Boundary layer theory, flow separation and dimensional analysis.
CO: 4 Evaluate the hydrodynamic forces of jet on vanes in different positions.
CO: 5 Understand the working Principles and performance evaluation of pump and hydraulic turbines.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the basic concepts of fluid properties			L2
CO2	Evaluate	the mechanics of fluids in static and dynamic conditions			L5
CO3	Apply	the Boundary layer theory, flow separation and dimensional analysis			L3
CO4	Evaluate	the hydrodynamic forces of jet on vanes in different positions			L5
CO5	Understand	the working Principles and performance evaluation of pump and hydraulic turbines			L2

Unit I:

Fluid statics: Dimensions and units: physical properties of fluids - specific gravity, viscosity and its significance, surface tension, capillarity, vapor pressure. Atmospheric, gauge and vacuum pressure, Measurement of pressure – Manometers - Piezometer, U-tube, inverted and differential manometers. Pascal's & hydrostatic laws**.**

Buoyancy and floatation: Meta center, stability of floating body. Submerged bodies. Calculation of meta center height. Stability analysis and applications.

Unit II

Fluid kinematics: Introduction, flow types. Equation of continuity for one dimensional flow, circulation and vorticity, Stream line, path line and streak lines and stream tube. Stream function and velocity potential function, differences and relation between them. Condition for irrotational flow, flow net, source and sink, double and vortex flow.

Fluid dynamics: surface and body forces –Euler's and Bernoulli's equations for flow along a streamline, momentum equation and its applications, force on pipe bend

Closed conduit flow: Reynold's experiment- Darcy Weisbach equation- Minor losses in pipes- pipes in series and pipes in parallel-total energy line-hydraulic gradient line.

Unit III

Boundary Layer Theory: Introduction, momentum integral equation, displacement, momentum and energy thickness, separation of boundary layer, control of flow separation, Stream lined body, Bluff body and its applications, basic concepts of velocity profiles.

Dimensional Analysis: Dimensions and Units, Dimensional Homogeneity, Non dimensionalization of equations Method of repeating variables and Buckingham Pi Theorem.

Unit IV

Basics of turbo machinery: hydrodynamic force of jets on stationary and moving flat, inclined, and curved vanes, jet striking centrally and at tip, velocity diagrams, workdone a defficiency, flow Over radial vanes.

Hydraulic Turbines: classification of turbines, impulse and reaction turbines, Pelton wheel, Francis turbine and Kaplan turbine-working proportions, work done, efficiencies, hydraulic design – draft tube-theory-functions and efficiency.

Unit V

Performance of hydraulic turbines: Geometric similarity, Unit and specific quantities, characteristic curves, governing of turbines, selection of type of turbine, cavitation, surge tank, water hammer. Hydraulic systems- hydraulic ram, hydraulic lift, hydraulic coupling. Fluidics – amplifiers, sensors and oscillators. Advantages, limitations and applications**.**

Centrifugal pumps: classification, working, work done – manometric head- losses and efficiencies-specific speed-pumps in series and parallel-performance characteristic curves, cavitation & NPSH. Reciprocating pumps: Working, Discharge, slip, indicator diagrams.

Text Books:

1. Y.A. Cengel, J.M. Cimbala, Fluid Mechanics, Fundamentals and Applications,6/e, McGraw Hill Publications, 2019.
2. 2. Dixon, Fluid Mechanics and Thermodynamics of Turbomachinery,7/e, Elsevier Publishers, 2014

Reference Books:

1. P N Modi and S M Seth, Hydraulics & Fluid Mechanics including Hydraulics Machines, Standard Book House, 2017.
2. RK Bansal, Fluid Mechanics and Hydraulic Machines, 10/e, Laxmi Publications(P)Ltd, 2019.
3. Rajput, Fluid Mechanics and Hydraulic Machines, S Chand & Company, 2016.
4. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S K Kataria &Sons, 2013.
5. D. Rama Durgaiah, Fluid Mechanics and Machinery,1/e, New Age International, 2002

Online Learning Resources:

- https://archive.nptel.ac.in/courses/112/105/112105206/
- https://archive.nptel.ac.in/courses/112/104/112104118/
- https://www.edx.org/learn/fluid-mechanics
- https://onlinecourses.nptel.ac.in/noc20_ce30/previewnptel.ac.in
- www.coursera.org/learn/fluid-powerera

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
FLUID MECHANICS & HYDRAULIC MACHINES	CO1	3	3	3									3	3
	CO2	3	3	3									3	3
	CO3	3	3	3									3	3
	CO4	3	3	3									3	3
	CO5	3	3	3									3	3

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours	CO	Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)

	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	15	20	2	Understand	L2	PO1 PO2 PO3	APPLY-L3 IDENTIY-L3 DESIGN-L3	2 2 2
2	17	23	3	Evaluate	L5	PO1 PO2 PO3	APPLY-L3 IDENTIY-L3 DESIGN-L3	3 3 3
3	13	18	2	Apply	L3	PO1 PO2 PO3	APPLY-L3 IDENTIY-L3 DESIGN-L3	3 3 3
4	16	22	3	Evaluate	L5	PO1 PO2 PO3	APPLY-L3 IDENTIY-L3 DESIGN-L3	3 3 3
5	13	18	2	Understand	L2	PO1 PO2 PO3	APPLY-L3 IDENTIY-L3 DESIGN-L3	2 2 2

Justification Statements:

CO1: Understand the basic concepts of fluid properties.

ActionVerb: Understand (L2)

PO1Verb: **Apply (L3)**

CO1 Action verb is less than level as PO1 verb. Therefore, the correlation is medium (2)

PO2 Verb: **Identify (L3)**

CO1 Action verb is less than level as PO2 verb. Therefore, the correlation is medium (2)

PO3 Verb: **Design (L3)**

CO1 Action verb is less than level as PO3 verb. Therefore, the correlation is medium (2)

CO2: Evaluate the mechanics of fluids in static and dynamic conditions.

Action Verb: Evaluate (L5)

PO1Verb: **Apply (L3)**

CO2 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Design (L3)**

CO2 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

CO3: Apply the Boundary layer theory, flow separation and dimensional

analysis.

ActionVerb: **Apply (L3**)

PO1Verb: **Apply (L3)**

CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO3 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Design (L3)**

CO3 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

CO4: Evaluate the hydrodynamic forces of jet on vanes in different positions.

ActionVerb: **Evaluate** (L5)

PO1Verb: **Apply (L3)**

CO4 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO4 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Design (L3)**

CO4 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

CO5: Understand the working Principles and performance evaluation of pump and hydraulic turbines.

ActionVerb: Understand (L2)

PO1Verb: **Apply (L3)**

CO5 Action verb is less than level as PO1 verb. Therefore, the correlation is medium (2)

PO2 Verb: **Identify (L3)**

CO5 Action verb is less than level as PO2 verb. Therefore, the correlation is medium (2)

PO3 Verb: **Design (L3)**

CO5 Action verb is less than level as PO3 verb. Therefore, the correlation is medium (2)

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: II** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0308	Theory of Machines	3	0	0	3

Course Outcomes:

CO: 1 Analyze different mechanisms, inversions of different kinematic chains and mobility of mechanisms.
CO: 2 Evaluate velocity and acceleration of different links in a mechanism.
CO: 3 Analyze the effects of gyroscopic couple on moving vehicles and the phenomenon of interference in gears.
CO: 4 Analyze the balancing masses for rotating members and cam profiles for different motions of the follower.
CO: 5 Evaluate the natural frequencies of mechanical systems based on governing equations and the turning moment diagrams for IC engines.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	different mechanisms, inversions of different kinematic chains and mobility of mechanisms			L4
CO2	Evaluate	velocity and acceleration of different links in a mechanism			L5
CO3	Analyze	the effects of gyroscopic couple on moving vehicles and the phenomenon of interference in gears			L4
CO4	Analyze	the balancing masses for rotating members and cam profiles for different motions of the follower			L4
CO5	Evaluate	the natural frequencies of mechanical systems based on governing equations and the turning moment diagrams for IC engines			L5

Unit I:

Simple Mechanisms: Classification of mechanisms – Basic kinematic concepts and definitions – Degree of freedom, mobility – Grashof's law, kinematic inversions of four bar chain and slider crank chains- Limit positions – Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line mechanisms – Universal Joint – Rocker mechanisms**.**

Unit II

Plane and motion analysis: Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations – kinematic analysis of simple mechanisms – slider crank mechanism dynamics – Coincident points – Coriolis component of acceleration.

Unit III

Gyroscope: Principle of gyroscope, gyroscopic effect in an aeroplane, ship, car and two-wheeler, simple problems.

Gear Profile: Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting – helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.

Unit IV

Balancing of Rotating masses: Need for balancing, balancing of single mass and several masses in different planes, using analytical and graphical methods**.**

Cams: Classification of cams and followers- Terminology and definitions – Displacement diagrams –Uniform velocity, parabolic, simple harmonic and cycloidal motions – derivatives of follower motions- specified contour cams- circular and tangent cams –pressure angle and undercutting.

Unit V

Vibrations & Turning Moment Diagrams and Flywheels

Vibrations: Introduction, degree of freedom, types of vibrations, free natural vibrations, Newton method and energy method for single degree of freedom. Damped vibrations- under damped, critically damped; and over damped systems, forced vibrations with and without damping in single degree of freedom; Vibration isolation and transmissibility.

Turning Moment Diagrams and Flywheels: Turning moment diagrams for steam engine, I.C engine and Multi Cylinder Engine. Crank effort – coefficient of fluctuation of energy, coefficient of fluctuation of speed – Fly Wheel and their design, fly wheels for punching press.

Text Books:

1. S.S. Rattan, Theory of Machines, 4/e, Tata Mc-Graw Hill, 2014.
2. P.L. Ballaney, Theory of Machines & Mechanisms, 25/e, Khanna Publishers, Delhi, 2003

Reference Books:

1. F. Haidery, Dynamics of Machines, 5/e, Nirali Prakashan, Pune, 2003.
2. J.E. Shigley, Theory of Machines and Mechanisms, 4/e, Oxford, 2014.
3. G.K. Groover, Mechanical Vibrations, 8/e, Nemchand Bros, 2009.
4. Norton, R.L., Design of Machinery – An Introduction to Synthesis and Analysis of Mechanisms and Machines, 2/e, McGraw Hill, New York, 2000.
5. William T. Thomson, Theory of vibration with applications, 4/e, Englewood Cliffs, N.J.: Prentice Hall, 1993

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Theory of Machines	CO1	3	3	3									3	3
	CO2	3	3	3									3	3
	CO3	3	3	3									3	3
	CO4	3	3	3									3	3
	CO5	3	3	3									3	3

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	14	17	2	Analyze	L4	PO1 PO2 PO3	Apply (L3) Identify (L3)	3 3 3

							Develop (L3)	
2	16	19.5	2	Evaluate	L5	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
3	16	19.5	2	Analyze	L4	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
4	18	22	3	Analyze	L4	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
5	18	22	3	Evaluate	L4	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3
	82	100						

Justification Statements:

CO1: Analyze different mechanisms, inversions of different kinematic chains and mobility of mechanisms.
Action Verb: Apply (L3)
PO1Verb: **Apply (L3)**
CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO1 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

CO2: Evaluate velocity and acceleration of different links in a mechanism.
Action Verb: Evaluate (L5)
PO1Verb: **Apply (L3)**
CO2 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO2 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

CO3: Analyze the effects of gyroscopic couple on moving vehicles and the phenomenon of interference in gears.
Action Verb: Analyze (L4)
PO1Verb: **Apply (L3)**
CO3 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO3 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO3 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

CO4: Analyze the balancing masses for rotating members and cam profiles for different motions of the follower.
Action Verb: Analyze (L4)
PO1Verb: **Apply (L3)**
CO4 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO4 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

CO5: Evaluate the natural frequencies of mechanical systems based on governing equations and the turning moment diagrams for IC engines.
Action Verb: Evaluate (L5)
PO1Verb: **Apply (L3)**
CO5 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO5 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO5 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: II** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0309	Fluid Mechanics & Hydraulic Machines Lab	0	0	3	1.5

Course Outcomes:

CO: 1 Apply the forces exerted by jet on vanes to measure discharge.
CO: 2 Evaluate the performance of centrifugal pump, reciprocating pump, Pelton wheel, Francis's turbine, Kaplan turbine etc.
CO: 3 Analyze the venturi-meter and orifice-meter to measure the discharge of flowing fluid.
CO: 4 Evaluate frictional losses in pipes with various diameters and Correction factor for given turbine meter
CO: 5 Apply the concepts of major and minor loss in pipes to measure coefficient of loss of head.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Apply	the forces exerted by jet on vanes to measure discharge.			L3
CO2	Evaluate	the performance of centrifugal pump, reciprocating pump, Pelton wheel, Francis turbine, Kaplan turbine etc.			L5
CO3	Analyze	the venturi-meter and orifice-meter to measure the discharge of flowing fluid.			L4
CO4	Evalute	frictional losses in pipes with various diameters and Correction factor for given turbine meter			L5
CO5	Apply	the concepts of major and minor loss in pipes to measure coefficient of loss of head.			L3

1. Impact of jets on Vanes.
2. Performance Test on Pelton Wheel.
3. Performance Test on Francis Turbine.
4. Performance Test on Kaplan Turbine.
5. Performance Test on Single Stage Centrifugal Pump.
6. Performance Test on Multi Stage Centrifugal Pump.
7. Performance Test on Reciprocating Pump.
8. Calibration of Venturimeter.
9. Calibration of Orificemeter.
10. Determination of friction factor for a given pipe line.
11. Determination of loss of head due to sudden contraction in a pipeline.
12. Turbine flow meter

Virtual Lab:

1. To study different patterns of a flow through a pipe and correlate them with the Reynolds number of the flow. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/reynolds/introduction.html)
2. To calculate Total Energy at different points of venture meter. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/bernoulli/introduction.html).
3. To calculate the flow (or point) velocity at center of the given tube using different flow rates. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/pitot/introduction.html)
4. To determine the hydrostatic force on a plane surface under partial submerge and full submerge condition. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/cop/introduction.html).
5. To determine the discharge coefficient of a triangular notch. (https://me.iitp.ac.in/Virtual-Fluid-Laboratory/notch/introduction.html)
6. To determine the coefficient of impact of jet on vanes. (https://fm-nitk.vlabs.ac.in/exp/impact-of-jet).
7. To determine friction in pipes. (https://fm-nitk.vlabs.ac.in/exp/friction-in-pipes/index.html).

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Fluid Mechanics & Hydraulic Machines Lab	CO1	3	2	2						2			2	2
	CO2	3	2	2						2			2	2
	CO3	3	2	2						2			2	2
	CO4	3	2	2						2			2	2
	CO5	3	2	2						2			2	2

CO	Verb	BTL	Program Outcomes (PO)	PO(s): Action Verb and BTL (for PO1 to PO5)	Level of Correlation
1	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Identify-L3 Develop-L3 Thumb Rule	3 3 3 3
2	Evaluate	L5	PO1 PO2 PO3 PO9	Apply-L3 Identify-L3 Develop-L3 Thumb Rule	3 3 3 3
3	Analyze	L4	PO1 PO2 PO3 PO9	Apply-L3 Identify-L3 Develop-L3 Thumb Rule	3 3 3 3
4	Evalute	L5	PO1 PO2 PO3 PO9	Apply-L3 Identify-L3 Develop-L3 Thumb Rule	3 3 3 3
5	Apply	L3	PO1 PO2 PO3 PO9	Apply-L3 Identify-L3 Develop-L3 Thumb Rule	3 3 3 3

Justification Statements:

CO1: Apply the forces exerted by jet on vanes to measure discharge . ActionVerb: **Apply (L3)**

PO1Verb: **Apply (L3)**

CO1 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO1 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop(L3)**

CO1 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: Thumb Rule

CO1 Action verb is same level as PO9 verb. Therefore, the correlation is high(3)

CO2: Evaluate the performance of centrifugal pump, reciprocating pump, Pelton wheel, Francis turbine, Kaplan turbine etc.

Action Verb: Evaluate (L5)

PO1Verb: **Apply (L3)**

CO2 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO2 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop(L3)**

CO2 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: Thumb Rule

CO2 Action verb is same level as PO9 verb. Therefore, the correlation is high(3)

CO3: Analyze the venturi-meter and orifice-meter to measure the discharge of flowing fluid.

ActionVerb: Analyze **(L4**)

PO1Verb: **Apply (L3)**

CO3 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO3 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop(L3)**

CO3 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: Thumb Rule

CO3 Action verb is same level as PO9 verb. Therefore, the correlation is high(3)

CO4: Evalute frictional losses in pipes with various diameters and Correction factor for given turbine meter

ActionVerb: **Evaluate** (L5)

PO1Verb: **Apply (L3)**

CO4 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO4 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop(L3)**

CO4 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: Thumb Rule

CO4 Action verb is same level as PO9 verb. Therefore, the correlation is high(3)

CO5: Apply the concepts of major and minor loss in pipes to measure coefficient of loss of head.

ActionVerb: **Apply (L3)**

PO1Verb: **Apply (L3)**

CO5 Action verb is same as level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO5 Action verb is same as level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop(L3)**

CO5 Action verb is same as level as PO3 verb. Therefore, the correlation is high (3)

PO9 Verb: Thumb Rule

CO Action verb is same level as PO9 verb. Therefore, the correlation is high(3)

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: II** **Branch of Study: ME**

Subject Code	Subject Name	L	T	P	Credits
23APC0310	Manufacturing Processes Lab	0	0	3	1.5

Course Outcomes:

CO: 1 Analyze the patter making, mould and sand properties for sand casting.
CO: 2 Apply the different welding techniques for joining of metal components
CO: 3 Apply the blow and injection moulding techniques for fabrication of different types of components.
CO: 4 Apply the sheet metal, deep drawing and extrusion operations for fabrication of metals.
CO: 5 Apply the 3D-Printing techniques for manufacturing various components

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Analyze	the patter making, mould and sand properties		for sand casting.	L4
CO2	Apply	the different welding techniques		for joining of metal components	L3
CO3	Apply	the blow and injection moulding techniques		for fabrication of different types of components.	L3
CO4	Apply	the sheet metal, deep drawing and extrusion operations		for fabrication of metals.	L3
CO5	Apply	the 3D-Printing techniques		for manufacturing various components.	L3

List of Experiments:

1. Design and making of pattern
   i. Single piece pattern
   ii. Split pattern
2. Sand properties testing
   i. Sieve analysis (dry sand)
   ii. Clay content test
   iii. Moisture content test
   iv. Strength test (Compression test & Shear test)
   v. Permeability test
3. Mould preparation
   i. Straight pipe
   ii. Bent pipe

iii. Dumble

iv. Gear blank

4. Gas cutting and welding
5. Manual metal arc welding
   i. Lap joint
   ii. Butt joint
6. Injection Moulding
7. Blow Moulding
8. Simple models using sheet metal operations
9. Study of deep drawing and extrusion operations
10. To make weldments using TIG/MIG welding
11. To weld using Spot welding machine
12. To join using Brazing and Soldering
13. To make simple parts on a 3D printing machine
14. Demonstration of metal casting

Virtual Lab:

1. To study and observe various stages of casting through demonstration of casting process. (https://virtual-labs.github.io/exp-sand-casting-process-dei/theory.html)
2. To weld and cut metals using an oxyacetylene welding setup. (https://virtual-labs.github.io/exp-gas-cutting-processes-iitkgp/index.html).
3. To simulate Fused deposition modelling process (FDM) (https://3dpdei.vlabs.ac.in/exp/simulation-modelling-process)
4. https://altair.com/inspire-mold/
5. https://virtual-labs.github.io/exp-simulation-cartesian-system-dei/theory.html

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Manufacturing Processes Lab	CO1	3	3	3		3	2			3			3	3
	CO2	3	3	3		3	2			3			3	3
	CO3	3		3		3	2			3			3	3
	CO4	3	3	3		3	1			3			3	3
	CO5	3		3		3	1			3			2	2

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	-	-	-	Analyze	L4	PO1 PO2 PO3 PO5 PO6	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule	3 3 3 3 2

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						PO9	Thumb Rule	3
2	-	-	-	Apply	L3	PO1 PO2 PO3 PO5 PO6 PO9	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule Thumb Rule	3 3 3 3 2 3
3	-	-	-	Apply	L3	PO1 PO3 PO5 PO6 PO9	Apply (L3) Develop (L3) Apply (L3) Thumb Rule Thumb Rule	3 3 3 2 3
4	-	-	-	Apply	L3	PO1 PO2 PO3 PO5 PO6 PO9	Apply (L3) Identify (L3) Develop (L3) Apply (L3) Thumb Rule Thumb Rule	3 3 3 3 1 3
5	-	-	-	Apply	L3	PO1 PO3 PO5 PO6 PO9	Apply (L3) Develop (L3) Apply (L3) Thumb Rule Thumb Rule	3 3 3 1 3

Justification Statements:

CO1: Analyze the patter making, mould and sand properties for sand casting.

Action Verb: Analyze (L4)

PO1 Verb: **Apply (L3)**

CO1 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO1 Action verb is same (greater) level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO1 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)

PO5 Verb: **Apply (L3)**

CO1 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)

PO6 and PO9 Verb: **Thumb Rule**

As per thumb rule, CO1 are co-relates moderately and highly with PO6 and PO9, correspondingly. Therefore, the correlation is medium (2) and high (3).

CO2: Apply the different welding techniques for joining of metal components.

Action Verb: Analyze (L4)

PO1 Verb: **Apply (L3)**

CO2 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO2 Action verb is same (greater) level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO2 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)

PO5 Verb: **Apply (L3)**

CO2 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)

PO6 and PO9 Verb: **Thumb Rule**

As per thumb rule, CO1 are co-relates moderately and highly with PO6 and PO9, correspondingly. Therefore, the correlation is medium (2) and high (3).

CO3: Apply the blow and injection moulding techniques for fabrication of different types of components.
Action Verb: **Apply (L3)**
PO1 Verb: **Apply (L3)**
CO3 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO3 Action verb is same (greater) level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO3 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO3 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)
PO6 and PO9 Verb: **Thumb Rule**
As per thumb rule, CO1 are co-relates moderately and highly with PO6 and PO9, correspondingly. Therefore, the correlation is medium (2) and high (3).

CO4: Apply the sheet metal, deep drawing and extrusion operations for fabrication of metals.
Action Verb: Analyze (L4)
PO1 Verb: **Apply (L3)**
CO4 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)
PO2 Verb: **Identify (L3)**
CO4 Action verb is same (greater) level as PO2 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO4 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO4 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)
PO6 and PO9 Verb: **Thumb Rule**
As per thumb rule, CO1 are co-relates slightly and highly with PO6 and PO9, correspondingly. Therefore, the correlation is low (1) and high (3).

CO5: Apply the 3D-Printing techniques for manufacturing various components
Action Verb: Analyze (L4)
PO1 Verb: **Apply (L3)**
CO5 Action verb is same (greater) level as PO1 verb. Therefore, the correlation is high (3)
PO3 Verb: **Develop (L3)**
CO5 Action verb is same (greater) level as PO3 verb. Therefore, the correlation is high (3)
PO5 Verb: **Apply (L3)**
CO5 Action verb is same (greater) level as PO5 verb. Therefore, the correlation is high (3)
PO6 and PO9 Verb: **Thumb Rule**
As per thumb rule, CO1 are co-relates slightly and highly with PO6 and PO9, correspondingly. Therefore, the correlation is low (1) and high (3).

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: II** **Branch of Study: Common to all**

Subject Code	Subject Name	L	T	P	Credits
23ASC9901	Soft Skills Lab	0	1	2	2

Course Outcomes:

CO: 1 Understand the concepts and principles of design thinking process.
CO: 2 Apply the design thinking techniques for solving problems in various sectors.
CO: 3 Analyze the art of innovation & creativity in product development.
CO: 4 Apply the design guidelines for produced development.
CO: 5 Analyze the design thinking strategies for solving real time business issues.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	Understand	the various techniques of soft skills and communication skills.			L2
2	Analyze	the listening and thinking skills to enhance professional development.			L4
3	Apply	the critical thinking skills in problem solving and decision making through Discussions .			L3
4	Evaluate	the emotional intelligence and stress management to control in themselves and others.			L5
5	Apply	the corporate etiquette atmosphere to enhance processional behavior in workplace environment.			L3

UNIT I Soft Skills & Communication Skills

Soft Skills - Introduction, Need - Mastering Techniques of Soft Skills – Communication Skills -Significance, process, types - Barriers of communication - Improving techniques.

Activities:

Intrapersonal Skills- Narration about self- strengths and weaknesses- clarity of thought – self- expression – articulating with felicity.
(The facilitator can guide the participants before the activity citing examples from the lives of the great, anecdotes and literary sources)
Interpersonal Skills- Group Discussion – Debate – Team Tasks - Book and film Reviews by groups - Group leader presenting views (non- controversial and secular) on contemporary issues or on a given topic.
Verbal Communication- Oral Presentations- Extempore- brief addresses and speeches- convincing- negotiating- agreeing and disagreeing with professional grace.
Non-verbal communication – Public speaking – Mock interviews – presentations with an objective to identify non- verbal clues and remedy the lapses on observation.

UNIT II Critical Thinking

Active Listening – Observation – Curiosity – Introspection – Analytical Thinking – Open-mindedness – Creative Thinking - Positive thinking - Reflection

Activities:

Gathering information and statistics on a topic - sequencing – assorting – reasoning – critiquing issues – placing the problem – finding the root cause - seeking viable solution – judging with rationale – evaluating the views of others - Case Study, Story Analysis

UNIT III Problem Solving & Decision Making

Meaning & features of Problem Solving – Managing Conflict – Conflict resolution – Team building - Effective decision making in teams – Methods & Styles

Activities:

Placing a problem which involves conflict of interests, choice and views – formulating the problem – exploring solutions by proper reasoning – Discussion on important professional, career and organizational decisions and initiate debate on the appropriateness of the decision.
Case Study & Group Discussion

UNIT IV Emotional Intelligence & Stress Management

Managing Emotions – Thinking before Reacting – Empathy for Others – Self-awareness – Self-Regulation – Stress factors – Controlling Stress – Tips

Activities:

Providing situations for the participants to express emotions such as happiness, enthusiasm, gratitude, sympathy, and confidence, compassion in the form of written or oral presentations.
Providing opportunities for the participants to narrate certain crisis and stress –ridden situations caused by failure, anger, jealousy, resentment and frustration in the form of written and oral presentation, Organizing Debates

UNIT V Corporate Etiquette

Etiquette- Introduction, concept, significance - Corporate etiquette - meaning, modern etiquette, benefits - Global and local culture sensitivity - Gender Sensitivity - Etiquette in interaction- Cell phone etiquette - Dining etiquette - Netiquette - Job interview etiquette -Corporate grooming tips -Overcoming challenges

Activities

Providing situations to take part in the Role Plays where the students will learn about bad and good manners and etiquette - Group Activities to showcase gender sensitivity, dining etiquette etc. - Conducting mock job interviews - Case Study - Business Etiquette Games

Prescribed Books:

1. Mitra Barun K, Personality Development and Soft Skills, Oxford University Press, Pap/Cdr edition 2012
2. Dr Shikha Kapoor, Personality Development and Soft Skills: Preparing for Tomorrow, I K International Publishing House, 2018

Reference Books:

1. Sharma, Prashant, Soft Skills: Personality Development for Life Success, BPB Publications 2018.
2. Alex K, Soft Skills S.Chand & Co, 2012 (Revised edition)
3. Gajendra Singh Chauhan & Sangeetha Sharma, Soft Skills: An Integrated Approach to Maximise Personality Published by Wiley, 2013
4. Pillai, Sabina & Fernandez Agna, Soft Skills and Employability Skills, Cambridge University Press, 2018

5. Soft Skills for a Big Impact (English, Paperback, Renu Shorey) Publisher: Notion Press
6. Dr. Rajiv Kumar Jain, Dr. Usha Jain, Life Skills (Paperback English) Publisher : Vayu Education of India, 2014

Online Learning Resources:

1. https://youtu.be/DUlsNJtg2L8?list=PLLy_2iUCG87CQhELCytvXh0E_y-bOO1_q
2. https://youtu.be/xBaLgJZ0t6A?list=PLzf4HHlsQFwJZel_j2PUy0pwjVUgj7KlJ
3. https://youtu.be/-Y-R9hDl7lU
4. https://youtu.be/gkLsn4ddmTs
5. https://youtu.be/2bf9K2rRWwo
6. https://youtu.be/FchfE3c2jzc
7. https://www.businesstrainingworks.com/training-resource/five-free-business-etiquette-training-games/
8. https://onlinecourses.nptel.ac.in/noc24_hs15/preview
9. https://onlinecourses.nptel.ac.in/noc21_hs76/preview

Course Title	Course Outcomes COs	Programme Outcomes (POs)											
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12
Soft Skills Lab	CO1										2		
	CO2									3	3		
	CO3									2			
	CO4									3			
	CO5									2	2		

CO-PO mapping justification:

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO6to PO11)	Level of Correlation (0-3)
	(Approx. Hrs)	%	corr	Verb	BTL			
1			CO1	UNDERSTAND	L2	PO10	Thumb rule	2
2			CO2	ANALYZE	L4	PO9, PO10	Thumb rule	3,3
3			CO3	APPLY	L3	PO9	Thumb rule	2
4			CO4	EVALUATE	L5	PO9	Thumb rule	3
5			CO5	Apply	L3	PO9, PO10	Thumb rule	2,2

CO1: Understand the various techniques of soft skills and communication skills.

Action Verb: Understand (L2)

CO1 Action Verb Understand is of BTL 2. Using Thumb rule, L2 correlates PO6 to PO11 as moderate (2).

CO2: Analyze the listening and thinking skills to enhance professional development.

Action Verb: Analyze **(L4)**

CO2 Action Verb Analyze is of BTL 4. Using Thumb rule, L4 correlates PO6 to PO11 as high (3)

CO3: Apply the critical thinking skills in problem solving and decision making through Discussions .

Action Verb: Apply (L3)

CO3 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

CO4: Evaluate the emotional intelligence and stress management to control themselves and others.

Action Verb: Evaluate **(L5)**

CO4 Action Verb Evaluate is of BTL 5. Using Thumb rule, L2 correlates PO6 to PO11 as high (3).

CO5: : : Apply the corporate etiquette atmosphere to enhance processional behavior in workplace environment.

Action Verb: Create e (L3)

CO5 Action Verb Apply is of BTL 3. Using Thumb rule, L3 correlates PO6 to PO11 as moderate (2).

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: II** **Branch of Study: Common to all**

Subject Code	Subject Name	L	T	P	Credits
23AES0304	Design Thinking & Innovation	0	1	2	2

Course Outcomes:

CO: 1 Understand the concepts and principles of design thinking process.
CO: 2 Apply the design thinking techniques for solving problems in various sectors.
CO: 3 Analyze the art of innovation & creativity in product development.
CO: 4 Apply the design guidelines for produced development.
CO: 5 Analyze the design thinking strategies for solving real time business issues.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concepts and principles of design thinking process.			L1
CO2	Apply	the design thinking techniques for solving problems in various sectors.			L3
CO3	Analyze	the art of innovation & creativity in product development.			L4
CO4	Apply	the design guidelines for produced development.			L3
CO5	Analyze	the design thinking strategies for solving real time business issues.			L4

Unit I:

Introduction to elements and principles of Design, basics of design-dot, line, shape, form as fundamental design components. Principles of design. Introduction to design thinking, historyof Design Thinking, New materials in Industry.

Unit II

Design thinking process (empathize, analyze, idea & prototype), implementing the process in driving inventions, design thinking in social innovations. Tools of design thinking - person, costumer, journey map, brainstorming, product development

Activity: Every student presents their idea in three minutes, Every student can present design process in the form of flow diagram or flow chart etc. Every student should explain about product development.

Unit III

Art of innovation, Difference between innovation and creativity, role of creativity and innovation in organizations- Creativity to Innovation- Teams for innovation- Measuring the impact and value of creativity.

Activity: Debate on innovation and creativity, Flow and planning from idea to innovation, Debate on value-based innovation.

Unit IV

Problem formation, introduction to product design, Product strategies, Product value, Product planning, product specifications- Innovation towards product design- Case studies

Activity: Importance of modelling, how to set specifications, Explaining their own product design.

Unit V

Design Thinking applied in Business & Strategic Innovation, Design Thinking principles that redefine business – Business challenges: Growth, Predictability, Change, Maintaining Relevance, Extreme competition, Standardization. Design thinking to meet corporate needs- Design thinking for Startups- Defining and testing Business Models and Business Cases- Developing & testing prototypes

Activity: How to market our own product, About maintenance, Reliability and plan for startup.

Text Books:

1. Tim Brown, Change by design, Harper Bollins (2009)
2. Idris Mootee, Design Thinking for Strategic Innovation, 2013, John Wiley & Sons.

Reference Books:

1. David Lee, Design Thinking in the Classroom, Ulysses press
2. Shrutin N Shetty, Design the Future, Norton Press
3. William Lidwell, Universal Principles of Design- Kritina holden, Jill Butter.
4. Chesbrough. H, The Era of Open Innovation – 2013

Online Learning Resources:

- https://nptel.ac.in/courses/110/106/110106124/
- https://nptel.ac.in/courses/109/104/109104109/
- https://swayam.gov.in/nd1_noc19_mg60/preview

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
CO1	Understand	the concepts and principles of design thinking process.			L1
CO2	Apply	the design thinking techniques for solving problems in various sectors.			L3
CO3	Analyze	the art of innovation & creativity in product development.			L4
CO4	Apply	the design guidelines for produced development.			L3
CO5	Analyze	the design thinking strategies for solving real time business issues.			L4

Course Title	COs	Programme Outcomes (POs) & Programme Specific Outcomes (PSOs)												
		PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
Design Thinking & Innovation	CO1	2		2									2	2
	CO2	2	2	2									2	2
	CO3	2	2	2			1						2	2
	CO4	2	2	2			1						2	2
	CO5	2	2	2			2						2	2

Correlation matrix

CO	Percentage of contact hours over the total planned contact hours			CO		Program Outcome (PO)	PO(s): Action verb and BTL (for PO1 to PO5)	Level of Correlation (0-3)
	Lesson Plan (Hrs)	%	correlation	Verb	BTL			
1	**11**	**20.3**	**L3**	**Understand**	**L2**	PO1 PO3	Apply (L3) Develop (L3)	2 2
2	**10**	**18.5**	**L2**	**Apply**	**L3**	PO1 PO2 PO3	Apply (L3) Identify (L3) Develop (L3)	3 3 3

3	**11**	**20.3**	**L3**	**Analyze**	**L4**	PO1 PO2 PO3 PO6	Apply (L3) Identify (L3) Develop (L3) Thumb Rule	3 3 3 1
4	**12**	**22.2**	**L3**	**Apply**	**L3**	PO1 PO2 PO3 PO6	Apply (L3) Identify (L3) Develop (L3) Thumb Rule	3 3 3 1
5	**10**	**18.5**	**L2**	**Analyze**	**L4**	PO1 PO2 PO3 PO6	Apply (L3) Identify (L3) Develop (L3) Thumb Rule	3 3 3 2
Total	**54**	**100**						

Justification Statements:

CO1: Understand the concepts and principles of design thinking process.

Action Verb: Understand (L2)

PO1Verb: **Apply (L3)**

CO1 Action verb is lower than PO1 verb. Therefore, the correlation is medium (2)

PO3 Verb: **Develop (L3)**

CO1 Action verb is lower than PO3 verb. Therefore, the correlation is medium (2)

CO2: Apply the design thinking techniques for solving problems in various sectors.

PO1 Verb: **Apply (L3)**

CO2 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO2 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO2 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

CO3: Analyze the art of innovation & creativity in product development.

Action Verb: **Analyze** (L4)

PO1 Verb: **Apply (L3)**

CO3 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO3 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO3 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is high (3)

PO6 Verb: Thumb Rule

As per thumb rule CO3 co-relates slightly with PO6 verb. Therefore, the correlation is high (3)

CO4: Apply the design guidelines for produced development.

Action Verb: Apply (L3)

PO1 Verb: **Apply (L3)**

CO4 Action verb is same level as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO4 Action verb is same level as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO4 Action verb is same level as PO3 verb. Therefore, the correlation is high (3)

PO6 Verb: Thumb Rule

As per thumb rule CO4 co-relates slightly with PO6 verb. Therefore, the correlation is high (3)

CO5: Analyze the design thinking strategies for solving real time business issues.

Action Verb: Analyze (L4)

PO1 Verb: **Apply (L3)**

CO5 Action verb is same level (greater) as PO1 verb. Therefore, the correlation is high (3)

PO2 Verb: **Identify (L3)**

CO5 Action verb is same level (greater) as PO2 verb. Therefore, the correlation is high (3)

PO3 Verb: **Develop (L3)**

CO5 Action verb is same level (greater) as PO3 verb. Therefore, the correlation is low (1)

PO6 Verb: Thumb Rule

As per thumb rule CO5 co-relates moderately with PO6 verb. Therefore, the correlation is high (3)

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MECHANICAL ENGINEERING (ME)

Year: II **Semester: II** **Branch of Study: AIML & DS**

Subject Code	Subject Name	L	T	P	Credits
23AMC9901	Environmental Studies	2	0	0	0

Course Outcomes:

CO: 1 Understand the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.
CO: 2 Understand the ecosystem and biodiversity to solve complex environmental problems
CO: 3 Apply the various types of pollution, solid waste management, and related preventive measures
CO: 4 Apply the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation.
CO: 5 Analyze the population explosion and impact of environmental health issues on human being.

CO	Action Verb	Knowledge Statement	Condition	Criteria	Blooms level
1	**Understand**	the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.			**L2**
2	**Understand**	the ecosystem and biodiversity	to solve complex environmental problems		**L2**
3	**Apply**	the various types of pollution, solid waste management, and related preventive measures			**L3**
4	**Apply**	the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation			**L3**
5	**Analyze**	the population explosion and impact of environmental health issues on human being.			**L4**

UNIT – I

Multidisciplinary Nature of Environmental Studies: Introduction – Multidisciplinary Nature of Environmental Studies – Definition, Scope and Importance – Need for Public Awareness.

Natural Resources: Renewable and non-renewable energy resources –Natural resources and associated problems.

Forest resources: Use and over – exploitation, deforestation, case studies – Timber extraction – Mining, dams and other effects on forest and tribal people.

Water resources: Use and overutilization of surface and sub-surface – Floods, drought, conflicts over water, dams – benefits and problems.

Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticides problems, water logging, salinity, case studies.

Energy resources: Renewable and non-renewable energy resources.

UNIT – II

Ecosystems: Concept of an ecosystem. – Structure and functions of an ecosystem – Producers, consumers and decomposers – Energy flow in the ecosystem – Ecological succession – Food chains, food webs and ecological pyramids – Introduction, types, characteristic features, structure and function of the following ecosystem: Forest ecosystem, Grassland ecosystem, Desert ecosystem and Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries).

Biodiversity And Its Conservation : Introduction- Definition:genetic, species and ecosystem diversity – Value of biodiversity: consumptive use, Productive use, social, ethical, aesthetic and option values – Biodiversity at global, National and local levels – India as a mega-diversity nation – Hot-sports of biodiversity – Threats to biodiversity:
habitat loss, poaching of wildlife, man - wildlife conflicts – Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

UNIT – III

Environmental Pollution: Definition, Causes, effects and its controlmeasures of: Air Pollution, Water pollution, Soil pollution, Marine pollution, Noise pollution, and Thermal pollution and Nuclear hazards.

Solid Waste Management: Causes**,** effects and control measures of urban and industrial wastes – Role of an individual in prevention of pollution – Pollution case studies – Disaster management: earthquakes, cyclones, tsunamis, and landslides.

UNIT – IV

Social Issues and the Environment: From Unsustainable to Sustainable development – Urban problems related to energy – Water conservation, Rainwater harvesting and Watershed Management – Resettlement and rehabilitation of people – Case studies – Environmental ethics: Issues and possible solutions – Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies– Wasteland reclamation. – Consumerism and waste products. – Environment Protection Act. – Air (Prevention and Control of Pollution) Act. – Water (Prevention and control of Pollution) Act – Wildlife Protection Act – Forest Conservation Act – Public awareness.

UNIT – V

Human Population and the Environment: Population growth, variation among nations. Population explosion – Family Welfare Programs. – Environment and human health – Human Rights – Value Education – HIV/AIDS – Women and Child Welfare – Role of Information Technology in Environment and human health – Case studies..

Textbooks:

1. Textbook of Environmental Studies for Undergraduate Courses Erach Bharucha for University Grants Commission, Universities Press.
2. Palaniswamy, “Environmental Studies”, Pearson education
3. S.Azeem Unnisa, “Environmental Studies” Academic Publishing Company
4. K.Raghavan Nambiar, “Text book of Environmental Studies for Undergraduate Courses as per UGC model syllabus”, Scitech Publications (India), Pvt. Ltd.

References:

1. Deeksha Dave and E.Sai Baba Reddy, “Textbook of Environmental Science”, Cengage Publications.
2. M.Anji Reddy, “Text book of Environmental Sciences and Technology”, BS Publication.
3. J.P.Sharma, Comprehensive Environmental studies, Laxmi publications.
4. J. Glynn Henry and Gary W. Heinke, “Environmental Sciences and Engineering”, Prentice hall of India Private limited
5. G.R.Chatwal, “A Text Book of Environmental Studies” Himalaya Publishing House
6. Gilbert M. Masters and Wendell P. Ela, “Introduction to Environmental Engineering and Science, Prentice hall of India Private limited.

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CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PSO1	PSO2
1						2	2						
2							2						
3						2	2						
4						2	2						
5							2						

(Levels of Correlation, viz., 1-Low, 2-Moderate, 3 High)

CO-PO mapping justification:

CO	**Percentage of contact hours over the total planned contact hours**				**CO**		**Program Outcome (PO)**	**PO(s): Action verb and BTL (for PO1 to PO5)**	**Level of Correlation (0-3)**
	Register (Hrs)	**Lesson Plan (Hrs)**	**%**	**corr**	**Verb**	**BTL**			
1	10	12	23	3	Understand	L2	PO6, PO7	Thumb Rule Thumb Rule	2, 2
2	15	15	28	3	Understand	L2	PO7	Thumb Rule	2
3	8	8	15	2	Apply	L3	PO6 PO7	Thumb Rule Thumb Rule	2, 2
4	9	10	19	2	Apply	L3	PO6, PO7	Thumb Rule Thumb Rule	2, 2
5	8	8	15	2	Analyze	L4	PO7	Thumb Rule	2
	50	**53**	**100**						

CO1: Understand the multidisciplinary nature of environmental studies, various renewable and nonrenewable resources.
Action Verb: Understand (L2)
Using Thumb rule,CO1correlatesPO6 and PO7 as a moderate (2)

CO2: Understand the ecosystem and biodiversity to solve complex environmental problems
Action Verb: Understand (L2)
Using Thumb rule, CO2 correlates PO7 as a moderate (2)
CO3: Apply the various types of pollution, solid waste management, and related preventive measures
Action Verb: APPLY (L3)
Using Thumb rule,CO3 correlates PO6 and PO7 as a moderate (2)

CO4: Apply the rainwater harvesting, watershed management, ozone layer depletion, and wasteland reclamation.
Action Verb: APPLY (L3)
Using Thumb rule,CO4 correlates PO6 and PO7 as a moderate (2)

CO5: Analyze the population explosion and impact of environmental health issues on human being
Action Verb: Analyze (L4)
Using Thumb rule,CO5 correlates PO7 as a moderate (2)

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