K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech.
Pattern 2022 Semester: III (Mechanical)
SMH222501: Applied Mathematics-III

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03hrs/week **Tutorial:01hr/week**	**03** **01**	**Continuous Comprehensive Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks** **Tutorial: 25Marks**

Prerequisite Courses: - Higher Secondary Mathematics

Course Objectives:

Find General solution of higher-order linear differential equation with constant & Variable coefficient using different Methods.

Find Laplace transform of functions using definition & properties & solve Ordinary D.E. using L.T.

Recognize nature of vector fields ,use different vector differential operators

Solve boundary value problems for Laplace's equation, heat equation, the wave equation by separation of variables.

Find Laplace transform of functions using definition & properties & solve Ordinary D.E. using L.T

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Identify nature of vector field, understand basic concept of L.D.E., Laplace transform.	2-Understanding
CO2	Calculate Laplace transform,Directional Derivative, Line Integral and solve L.D.E. using different Methods. Develop & Solve mass spring system, P.D.E.	3- Apply
CO3	APPLY Integral transform techniques such as Laplace transform to solve differential equations involved in vibration theory, heat transfer and related mechanical engineering applications.	3- Apply
CO4	APPLY Statistical methods like correlation, regression in analyzing and interpreting experimental data applicable to reliability engineering and probability theory in testing and quality control.	3- Apply
CO5	Apply Concept of Differential equations, Vector Calculus, Statistics and Probability to various applications including real life problem.	4 -Analyze

COURSE CONTENTS

Unit I	**Transforms**	**(08hrs+2hrsTutorial)**	**COs Mapped - CO1, CO2, CO3**

Laplace Transform (LT): LT of standard functions, properties and theorems, Inverse LT, Application of LT to solve LDE.

Unit II	**Linear Differential Equations with Constant Coefficient**	**(08hrs+ 2hrsTutorial)**	**COs Mapped - CO1, CO2**

LDE of nth order with constant coefficients, Method of variation of parameters, Cauchy's & Legendre's

DE, Simultaneous DE.

Unit III	Applications of Linear Differential Equations& Partial Differential Equations	(08hrs+ 2hrsTutorial)	COs Mapped – CO2, CO3,CO5

Modelling of Mass-spring systems, Free & Forced Damped and undamped systems. Basic concepts, method of separation of variables, Wave equation, one and two dimensional Heat flow equations.

Unit IV	Statistics and Probability	(08hrs+ 2hrsTutorial)	COs Mapped - CO3, CO4,CO5

Measures of central tendency, Measures of dispersion: Standard deviation, Coefficient of variation, Moments, Skewness and Kurtosis, Correlation and Regression, Curve fitting: fitting of straight line, parabola and related curves, Correlation and Regression, Reliability of Regression Estimates. Probability, Probability distributions: Binomial, Poisson and Normal distributions

Unit V	Vector Calculus	(08hrs+ 2hrsTutorial)	COs Mapped - CO4,CO5

Vector differentiation, Gradient, Divergence and Curl, Directional derivative, Solenoid and Irrotational fields, Vector identities

TextBooks

1. B.V. Ramana, “Higher Engineering Mathematics”, Tata McGraw-Hill.
2. B. S. Grewal, “Higher Engineering Mathematics”, Khanna Publication, Delhi.
3. Advanced Engineering Mathematics,7e, by peter V.O’Neil(Thomson Learning)

Reference Books

1. Erwin Kreyszig ,”Advanced Engineering Mathematics” ,Wiley Eastern Ltd.
2. P. N. Wartikar and J. N. Wartikar, ”Applied Mathematics” (Volumes I and II), Pune Vidyarthi Griha Prakashan, Pune.
3. Advanced Engineering Mathematics, 2e, by M. D. Greenberg (Pearson Education).

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	-	-	-	-	-	-	-	-	-	3
CO2	3	3	-	-	2	-	-	-	-	-	-	3
CO3	3	2	-	2	2	-	-	-	-	-	-	3
CO4	3	2	2	3	2	-	-	-	-	-	-	3
CO5	3	-	-	-	2	-	-	-	-	-	-	3

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignments (Total 3 Assignment, Unit I and II 20 marks, Unit III and IV 20 marks and Unit V 10 marks & 50 marks will be converted to 10 Marks)	10
2	Tests on each unit using LearniCo (Each test for 15 M and total will be converted out of 10 M)	10

List of Tutorial Assignments		
Sr. No.	**Title**	**CO Mapped**
1	Examples on Laplace transform properties and theorems.	CO1, CO2, CO3
2	Examples on Inverse Laplace transform properties and theorems.	CO1, CO2, CO3
3	Solve problems on matrices using Matlab.	CO1, CO2, CO3,CO4
4	Solve system of equations using Matlab.	CO1, CO2, CO3, CO4
5	Examples on LDE of nth order with constant coefficients.	CO1, CO2, CO3
6	Examples on Method of variation of parameters, Cauchy's & Legendre's DE, Simultaneous DE.	CO1, CO2, CO3
7	Examples on Applications of LDE to chemical engineering problems and mass spring system.	CO3, CO4,CO5
8	Examples on modeling of Vibrating string, Wave equation, one and two dimensional Heat flow equations.	CO3, CO4,CO5
9	Examples on Vector differentiation.	CO4,CO5
10	Examples on Vector Integration.	CO4,CO5

Guidelines for Tutorial / Termwork Assessment		
Sr. No.	**Components for Tutorial / Termwork Assessment**	**Marks Allotted**
1	Assignment on computational software	5
2	Tutorial (Each tutorial carries 15 marks)	15
3	Attendance (Above 95 % : 05 Marks, below 75% : 0 Marks)	5

K.K.Wagh Institute of Engineering Education and Research, Nashi
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech.
Pattern 2022 Semester: III (B.Tech Mechancial)
MEC222002: Fluid Mechanics

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any: -

Course Outcomes: On completion of the course, students will be able to –

	Course Outcomes	**Bloom's Level**
CO1	Gain fundamental knowledge of fluid, its properties and behaviour under various conditions of internal and external flows.	1-Knowledge
CO2	Develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.	2-Understand
CO3	Imbibe basic laws and equations used for analysis of static and dynamic fluids.	2-Understand
CO4	Determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies	3-Apply
CO5	Estimate the Internal flows, External flows, Boundary layers, Drags and Lift.	3-Apply

COURSE CONTENTS

Unit I	**Fluid Properties and Fluid statics**	**(10hrs)**	**COs Mapped - CO1, CO2**

Properties of fluids: Density, specific weight, specific volume, specific gravity, viscosity, compressibility, vapour pressure, capillarity and surface tension.
Fluid statics: Concept of fluid static pressure, absolute and gauge pressures. Pressure measurements by manometers, Hydrostatic forces on planes: centre of pressure, buoyancy and floatation.

Unit II	**Fluid Kinematics**	**(08hrs)**	**COs Mapped - CO1, CO2,CO3**

Fluid Kinematics: Classification and types of flow, velocity field and acceleration, continuity equation (one and three dimensional differential forms). Stream line, streak line, path line, stream function, velocity potential function, flow net.

Unit III	**Fluid Dynamics And Dimensional Analysis**	**(10hrs)**	**COs Mapped - CO1, CO2, CO3**

Fluid dynamics: Equations of motion: Navier's stokes equation, Euler's equation along a streamline, Bernoulli's equation, flow measuring devices (venturi meter, orifice meter and Pitot tube). Linear

momentum equation and its application to pipe bend (Air conditioning , etc).
Dimensional Analysis: Fundamental dimensions, dimensional homogeneity, Rayleigh's method and Buckingham Pi-theorem, dimensionless parameters, similitude's and model studies, distorted models

Unit IV	**Analysis of Flow Through Pipes**	**(08hrs)**	**COs Mapped - CO1, CO3,CO4**

Reynold's experiment, laminar flow through stationary plates and circular pipe (Hagen poiseulle's), hydraulic and energy gradient, flow through pipes, Darcy – Weisbach's equation, pipe roughness, friction factor, Moody's diagram, major and minor losses of flow in pipes, pipes in series and in parallel. Case study of piping system in hydraulic power plant, pumping station, domestic water supply system

Unit V	**Boundary Layer theory**	**(08hrs)**	**COs Mapped - CO1, CO2, CO5**

Boundary layer: definition, Boundary layer for external and internal flows, laminar and turbulent boundary layer displacement, energy and momentum thickness, Boundary layer separation and control, drag and lift forces. Case study on applications of boundary layer concept for wind turbine blade, blower blade, car, airplane, duct design, piping system

Text Books

1. Introduction to Fluid Mechanics- Fox, Pichard , McDonald, Wiley
2. Fluid Mechanics- F. M. White, TATA McGraw-Hill
3. Fluid Mechanics,- Dr. R.K. Bansal- Laxmi Publication (P) Ltd. New Delhi
4. Fluid Mechanics,- Cengel & Cimbla, TATA McGraw-Hill
5. Hydraulics and Fluid Mechanics - Modi P. N. and Seth S. M, Standard Book House
6. Fundamentals of Fluid Mechanics- Munson, Young and Okiishi, Wiley India
7. Fluid Mechanics- Potter Wiggert , Cengage Learning

Reference Books

1. Fluid Mechanics-Kundu, Cohen, Dowling, Elsevier India
2. Fluid Mechanics- Chaim Gutfinger David Pnueli, Cambridge University press.
3.Introduction to Fluid Mechanics- Edward Shaughnessy, Ira Katz James Schaffer, OXFORD University Press

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Three Assignments on unit-1, Unit-2, Unit-3 , Unit-4, Unit-5	15
2	LearniCo Test on Each Unit	05
	Total	**20**

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Determination of pressure using manometers (minimum two)	**CO1, CO2**
2	Determination of fluid viscosity and its variation with temperature	**CO1**
3	Determination of Metacentric height of floating object	**CO1,CO2**
4	Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus.	**CO1, CO3**

5	Draw flow net using electrical analogy apparatus to calculate discharge for rectangular / enlargement / contraction channel	**CO1, CO2**
6	Verification of modified Bernoulli's equation	**CO2,CO3**
7	Calibration of Orifice meter/ Venturi meter	**CO5**
8	Determination of minor/major losses through metal/non-metal pipes	**CO4, CO5**
9	Analysis of flow through pipe using CFD tool	**CO1, CO3, CO4, CO5**

Guidelines for Laboratory Conduction

1. Teacher will brief the given experiment to students its procedure, observations calculation, and outcome of this experiment.
2. Apparatus and equipments required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
4. After performing the experiment students will check their readings, calculations from the teacher.
5. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Termwork Assessment

1. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

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S. Y. B. Tech.
Pattern 2022 Semester: III (Mechanical Engineering)
MEC222003 :Engineering Metallurgy

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses: - Fundamentals of Physics and Chemistry

Course Objectives:

4. To impart fundamental knowledge of ferrous materials
5. To Know Fundamentals of Metallography
6. To select Ferrous Metals & Alloys
7. To learn industrial safety and use of industrial equipment
8. To develop futuristic insight into Metals

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
Course Outcomes	**Description**	**Course Outcomes**
CO1	Summarize core concepts of metal extraction and crystal imperefection	2 - Understanding
CO2	Illustrate the effects of solid solutions through microscopic techniques	3 - Applying
CO3	Discuss effects of heating and cooling rate on heat treatment processes	2 - Understanding
CO4	Explain designation of ferrous metals and surface treatments	2 - Understanding
CO5	Describe use of safety rules and equipments in metal industries	2 - Understanding

COURSE CONTENTS

Unit I	**Extractive Metallurgy and Crystal Imperfections**		

Extractive Metallurgy: Types of furnaces for extraction. Secondary treatment of steels and nonferrous alloys. Rare earth extraction
Mechanical Properties: Strength, Hardness, Toughness, Ductility, Malleability, Fatigue, Creep
Crystal Structures: Miller Indices, Crystal Imperfections (Point, line defects (Dislocation), surface and volume defects), Defects during solidification

Unit II	**Microscopic Techniques and Fundamentals of Phase Diagrams**		

Microscopic Techniques: Specimen Preparation, fundamentals of microscopy, electronic microscopy (SEM & TEM), Bragg's Law, X-ray diffraction (Principle and Applications only)
Macroscopy: Physical detection of impurities like sulphur, spark test, spectrometry
Solid solutions: Introduction, Types, Hume Rothery rule , **Solidification:** Nucleation & crystal growth, solidification of pure metals, solidification of alloys.
Phase Diagrams: Cooling curves, types of phase diagrams, Gibbs phase rules , Illustration of common

microstructures			
Unit III	**Iron Carbon Diagram and Heat Treatment**		
Iron Carbon Diagram, Heating rate and cooling rate of Steel, Transformation products of austenite Heat Treatment : TTT diagram, CCT diagram and uses for Heat Treatment processes like Stress Relieving , Annealing, Normalizing, Hardening, Retained Austenite, Tempering Case Hardening: Carburizing, Nitriding, Carbonitriding, Flame Hardening, Induction Hardening Furnaces and equipment for heat treatment			
Unit IV	**Designation of Ferrous Metals and Coating Techniques**		
Steels specification as per various standards like ASTM, EN, IS etc. Types and Effects of Alloying elements on properties of steel, Specification of Cast Iron, Steel Introduction to Surface Treatments like Plating, coating, galvanizing, blackodizing, anodic and cathodic protection etc.			
Unit V	**Equipments used in Metal Industries**		
Introduction to various equipment used in industries like casting, forging, rolling, wire drawing, extrusion, sheet metal shop, Introduction to Industrial Safety - PPE			

TextBooks

Text Books

1. Dr. V. D. Kodgire & S. V. Kodgire, “Material Science & Metallurgy For Engineers”, Everest Publication.
2. William D. Callister, “Materials Science and Engineering an Introduction”, Jr, John Wiley & Sons, Inc.

Reference Books

1 **References Books**

1. Raghvan V., “Material Science & Engineering”,Prentice Hall of India, New Delhi. 2003
2. Avner, S.H., “Introduction to Physical Metallurgy”, Tata McGraw-Hill, 1997.
3. Higgins R. A., “Engineering Metallurgy”, Viva books Pvt. Ltd.
4. George Ellwood Dieter, “Mechanical Metallurgy”, McGraw-Hill 1988
5. Smith, W.F, Hashemi, J., and Prakash, R., “Materials Science and Engineering in SI Units”, Tata McGraw Hill Education Pvt. Ltd.

Strength of CO-PO Mapping

	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	2	-	-	-	-	-	-	-	-	2	-	1
CO2	2	1	-	-	2	-	-	-	2	2	-	2
CO3	2	-	-	-	1	-	-	-	2	2	-	1
CO4	2	-	-	-	1	2	-	-	1	2	-	1
CO5	2	-	-	-	-	1	-	-	1	2	-	2

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Alloted
1	Assignments (Total 3 Assignment, Unit I and II 20 marks, Unit III and IV 20 marks	10

	and Unit V 10 marks & 50 marks will be converted to 10 Marks)	
2	Formative Test on each unit using LearniCo (Each test for 10 Mark and total will be converted out of 10 Mark)	10

Guidelines for Assessment		
Sr. No.	**Components for Tutorial / Termwork Assessment**	**Marks Allotted**
1	Oral Examination will be conducted for 50 marks after fulfillment of all the necessary laboratory work to assess students understanding.	50

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S. Y. B. Tech.
Pattern 2022 Semester: III (Mechanical)
MEC222004: Basic Electronics for Mechanical Engineering

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses: -

Course Objectives:

1. Provides the student with the fundamental skills to understand the basic of semiconductor and electronics components
2. Learn to design circuits and instrumentation
3. To acquire specialized knowledge on electronic-mechanical engineering and its relevant fields, and the ability to use that knowledge for solving technical problems

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Understand basics of electronics components	2-Understanding
CO2	Describe various types of Electronics Measuring instruments & standards	2-Understanding
CO3	Select appropriate type of sensor and signal conditioning circuit for mechanical applications	2-Understanding
CO4	Discuss types of microcontroller & programming techniques	2-Understanding
CO5	Explain applications of Electronics in Mechanical field	2-Understanding

COURSE CONTENTS

Unit I	**Fundamentals of Electronics**	**(06hrs)**	**COs Mapped - CO1**

Basics : Resistors, Capacitors Inductors, Diodes, Rectifiers, Filters, Transistors, Bipolar junction transistor, Field effect transistor, MOSFETs

Digital Electronics : Binary numbers, Boolean algebra, logic gates and truth tables, flip flops, counters and registers, clock, Schmitt trigger, 555 timer, combinational logic circuits, multiplexers and decoders, sequential logic circuits

Unit II	**Electronics Measuring Instruments, Displays & Standards**	**(06hrs)**	**COs Mapped - CO2**

Digital Multimeter, Function generator, Cathode Ray Oscilloscope(CRO), Digital Storage Oscilloscope(DSO), Tachometer, Power supply, voltage regulators

Displays : LED display, LCD display, Seven segment display, OLED

Standards & Protocols : IEEE standards, Wireless LAN standards, Internet protocols, protocols for automotive applications such as, I2C, CAN, MOST,

Unit III	**Sensors Interfacing**	**(08hrs)**	**COs Mapped –CO3**

Sensor fundamentals: Definition of sensor & transducer, types of sensors (Temperature, pressure, flow, Load cell, displacement sensor, speed sensor etc.), selection criteria of sensors,
Actuators: Relays, Solenoids, Various types of electric motors and piezoelectric force generators.
Instrumentation : Types of signals, Amplifiers, Active & passive filters, Operational amplifiers, Current to voltage and voltage to current converters, A/D & D/A converter circuits, Integrator, Differentiator, Isolators, Optocouplers, Power circuit for motor control, Signal conditioning circuit for Temperature/speed measurement.

Unit IV	**Microcontroller**	**(06hrs)**	**COs Mapped – CO4**

Introduction, Block diagram of Microcontroller, Need & applications, Selection criteria of Microcontroller, Types of Microcontroller, Comparison, Microcontroller vs. Microprocessor, Microcontroller programming, Arduino, Rasberry Pi, Programming and interfacing with Sensors & actuators, Various Types of Electronics control Unit(ECU) in automotive applications

Unit V	**Embedded system & Electronic communication**	**(04hrs)**	**COs Mapped – CO5**

Embedded system : Introduction, Components of Embedded system, structure and Mechanical applications
Electronics communication: Digital communication, series, parallel, synchronous, Asynchronous, AM, FM, GSM, Cellular concept, Introduction to 5G, WIFI.

Textbooks

1. Mechatronics: Electronic Control Systems in Mechanical and Electrical Engineering by William Bolton, 7th edition, published by Pearson
2. Mechatronics: Integrated Mechanical Electronic Systems by K.P Ramchandran, Wiley publication

Reference Books

1. Microprocessors, instrumentation and control by Charles J. Fraser, John S. Milne, Ben Noltingk
2. Electronics Circuits And Systems by Owen Bishop 7th edition
3. Understanding Automotive Electronics (Seventh Edition) by William B. Ribbens

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Alloted**
1	Assignments (Total 3 Assignment, Unit I and II 20 marks, Unit III and IV 20 marks and Unit V 10 marks &50 marks will be converted to 10 Marks)	10
2	Tests on each unit using LearniCo (Each test for 15 M and total will be converted out of 10 M)	10

K. K. Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: III (Mechanical Engineering)
MEC222005: Manufacturing Processes

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **In Sem Exam: 20Marks** **End Sem Exam: 60Marks**

Prerequisite Courses, if any: - Knowledge of Materials and their properties, Stress-Strain Diagrams, Change in properties of metals on Heating and cooling, etc.

Course Objectives:

- To Learn Casting Processes, permanent and collapsible molds including melting, molding, core and sand making and finishing.
- To Learn basics of metal forming processes like Rolling, Forging, Extrusion and Drawing, equipment and tooling
- To Learn sheet metal forming operations and die design.
- To Learn the principles ofwelding.
- To Learnpolymers, its processes.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Identify appropriate manufacturing process for product under consideration and source of defect in manufacturing process.	1-Knowledge
CO2	Understand the mechanism of metal forming techniques and demonstrate basics operations.	2-Understand
CO3	Explain the welding process and estimate welding efficiency, Effect of welding parameters on welding quality.	2-Understand
CO4	Relate the principle of manufacturing polymers.	2-Understand

COURSE CONTENTS

Unit I	**Casting Processes**	**(07hrs)**	**COs Mapped - CO1**

Introduction to casting processes, Patterns: Types of pattern and Allowances, Moulding sand, Core making, Melting practices and furnaces, Pouring and Gating system design, Riser design and placement, Cleaning and Finishing of casting, Surface coating and marking of Casting, Defects and remedies, Principle and equipments of Permanent mould casting, Investment casting, Centrifugal casting, Continuous casting

Unit II	**Metal Forming Process**	**(08hrs)**	**COs Mapped - CO1, CO2**

Rolling Process: Friction in rolling, Calculation of rolling load and power. Forging: Open and closed die forging, Forging stages, Extrusion: Types, Process parameter, Wire Drawing, Die profile Friction and lubrication in metal forming, Forming defects, causes and remedies for all forming processes.

Unit III	Sheet Metal Working	(07hrs)	COs Mapped - CO1, CO2
Types of sheet metal operations, Press working equipment, Types of dies, Clearance analysis, Estimation of cutting forces, Centre of pressure and blank size determination, Design of strip lay-out, Blanking die design, Introduction to Drawing, Methods of reducing cutting forces, Formability and forming limit diagrams, Spring Back Effect.			
Unit IV	**Welding Processes**	**(08hrs)**	**COs Mapped - CO1, CO3**
Classification of joining processes, types of joints Arc Welding Processes: Principles and equipment's of Single carbon arc welding, FCAW, TIG, MIG, SAW Resistance Welding: Spot, Seam and Projection weld process, Heat balance in resistance welding Gas Welding and Cutting, Soldering, brazing and braze welding, Weld quality and inspection, Defects in various joints and their remedies. Linear and droop characteristics. Numerical on welding efficiency.			
Unit V	**Introduction to Polymers Processing**	**(08hrs)**	**COs Mapped - CO1,CO4**
Introduction to Polymers, Classification of Polymers: Thermoplastic and Thermosetting Plastic Manufacturing Process :Moulding: Compression moulding, Transfer moulding, Blow moulding, Centrifugal moulding, Injection moulding - Process and equipment Extrusion of Plastic: Type of extruder, extrusion of film, pipe, Cable and Sheet – Principle Pressure Forming and Vacuum Forming.			

Text Books

1. P. N. Rao, "Manufacturing Technology Vol. I & II" , Tata McGraw Hill Publishers
2. S. K. HajraChoudhary, A. K. HajraChoudhary, Nirjhar Roy, "Elements of Workshop Technology", Volume I, Media Promoters and Publisher Pvt, Ltd.
3. P. C. Sharma, "Production Engineering", Khanna Publishers

Reference Books

1. R. K. Jain, "Production Technology", Khanna Publishers
2. K. C. Chawala, "Composite Materials", Springer, ISBN 978-0387743646, ISBN 978-0387743653
3. Brent Strong, "Fundamentals of Composites Manufacturing: Materials, Methods", SME Book series.

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	2	-	-	-	2	-	-	-	-	2
CO2	3	2	3	-	-	1	1	-	-	-	-	1
CO3	2	2	-	-	-	-	-	-	-	-	-	1
CO4	2	-	-	1	-	1	-	-	-	-	-	2
Average	2	2	3	1	-	1	2	-	-	-	-	2

Guidelines for Continuous Comprehensive Evaluationof Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Three Assignments on Unit-1, Unit-2&3, Unit-4 & 5	05
2	Group Presentation	10
3	LearniCo Test on Each Unit	05
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech.
Pattern 2022 Semester: III (Mechanical Engineering)
MEC222006: Engineering Economics

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :01 hrs/week	**01**	**TermWork: 25 Marks**

Prerequisite Courses : - Mathematics, Business finance

Course Objectives:
9. To analyze and evaluate engineering projects
10. To make decisions based on economic criteria
11. To apply financial principles to engineering problems
12. To understand time value of money
13. To Develop critical thinking and problem-solving skills

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	Analyze engineering projects by estimating costs, projecting cash flows, and calculating rates of return.	4- Analyze
CO2	To calculate present and future values, as well as perform inflation, interest rate, and compounding calculations	3- Apply
CO3	To evaluate different alternatives based on economic criteria such as net present value, internal rate of return, and payback period	5- Evaluate
CO4	To develop critical thinking and problem-solving skills necessary to analyze complex problems and identify potential solutions.	6 - Create

COURSE CONTENTS

Unit I	**Introduction to Engineering Economics**	**(02hrs)**	**COs Mapped – CO1, CO2, CO3**

Definition and scope of Engineering Economics, Basic concepts: Interest, Time Value of Money, Cash Flows, and Equivalence, Economic Criteria for Decision Making

Unit II	**Cost Concepts and Analysis**	**(02hrs)**	**COs Mapped - CO1, CO2, CO3, CO4**

Types of costs: Fixed, Variable, Direct and Indirect, Cost-Volume-Profit (CVP) analysis, Break-even analysis, Marginal Costing

Unit III	**Time Value of Money**	**(02hrs)**	**COs Mapped - CO1, CO2, CO3, CO4**

Future value and Present value, Simple and Compound Interest, Annuities, Perpetuities

Unit IV	**Evaluation of Engineering Projects**	**(02hrs)**	**COs Mapped - CO1, CO2, CO3, CO4**

Project life cycle, Capital Budgeting Techniques: Payback period, Net Present Value (NPV), Internal Rate of Return (IRR), Profitability Index (PI)

Unit V	**Depreciation and Taxes**	**(02hrs)**	**COs Mapped - CO1, CO2, CO3, CO4**

Types of Depreciation: Straight Line, Declining Balance, Sum of the years' digits, and Double, Declining Balance, Taxation and its impact on investment decisions

Text Books

1. Engineering Economic Analysis by Donald G. Newnan, Jerome P. Lavelle, and Ted G. Eschenbach
2. Contemporary Engineering Economics by Chan S. Park
3. Fundamentals of Engineering Economics by Chan S. Park
4. Engineering Economics and Financial Accounting by A. Ramachandra Aryasri
5. Engineering Economy by William G. Sullivan, Elin M. Wicks, and C. Patrick Koelling
6. Principles of Engineering Economic Analysis by John A. White and Kenneth E. Case
7. Basic Engineering Economics by Chan S. Park
8. Engineering Economic Analysis: Study Guide by Donald G. Newnan, Jerome P. Lavelle, and Ted G. Eschenbach

Reference Books

1. Engineering Economic Analysis: Enhanced Tenth Edition by Donald G. Newnan, Ted G. Eschenbach, and Jerome P. Lavelle
2. Engineering Economics Analysis: Solutions Manual by Donald G. Newnan, Ted G. Eschenbach, and Jerome P. Lavelle
3. Essentials of Engineering Economic Analysis by Donald G. Newnan, Jerome P. Lavelle, and Ted G. Eschenbach
4. Introduction to Engineering Economics by E. Paul DeGarmo, Delores M. Etter, and Jayant V. Deshpande
5. Engineering Economy: Global Edition by William G. Sullivan, Elin M. Wicks, and C. Patrick Koelling

Strength of CO-PO Mapping

	PO												PSO	
	1	2	3	4	5	6	7	8	9	10	11	12	1	2
CO1	2	-	-	2	2	-	-	-	-	-	3	-	-	-
CO2	2	2	-	-	2	-	-	-	-	-	2	-	-	-
CO3	2	3	2	-	-	2	-	2	2	2	3	2	-	-
CO4	2	3	2	2	2	2	-	-	2	2	2	2	3	3
Average	2	2.66	4	4	2	2	-	2	2	2	2.5	2	3	3

Guidelines for Teamwork Assessment

3. Each unit will be evaluated through an assignment worth 30 marks, which will be assessed using three rubrics.
4. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech. **Pattern 2022 Semester: III (B.Tech Mechancial)** **MEC222007: Fluid Mechanics Lab**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Practical: 25 Marks**
Prerequisite Courses, if any: -		
Course Outcomes: On completion of the course, students will be able to –		

	Course Outcomes	**Bloom's Level**
CO1	Gain fundamental knowledge of fluid, its properties and behaviour under various conditions of internal and external flows.	1-Knowledge
CO2	Develop understanding about hydrostatic law, principle of buoyancy and stability of a floating body and application of mass, momentum and energy equation in fluid flow.	2-Understand
CO3	Imbibe basic laws and equations used for analysis of static and dynamic fluids.	2-Understand
CO4	Determine the losses in a flow system, flow through pipes, boundary layer flow and flow past immersed bodies	3-Apply
CO5	Estimate the Internal flows, External flows, Boundary layers, Drags and Lift.	3-Apply

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Determination of pressure using manometers (minimum two)	**CO1, CO2**
2	Determination of fluid viscosity and its variation with temperature	**CO1**
3	Determination of Metacentric height of floating object	**CO1,CO2**
4	Determination of Reynolds number and flow visualization of laminar and turbulent flow using Reynolds apparatus.	**CO1, CO3**
5	Draw flow net using electrical analogy apparatus to calculate discharge for rectangular / enlargement / contraction channel	**CO1, CO2**

6	Verification of modified Bernoulli's equation	**CO2,CO3**
7	Calibration of Orifice meter/ Venturi meter	**CO5**
8	Determination of minor/major losses through metal/non-metal pipes	**CO4, CO5**
9	Analysis of flow through pipe using CFD tool	**CO1, CO3, CO4, CO5**

Guidelines for Laboratory Conduction

6. Teacher will brief the given experiment to students its procedure, observations calculation, and outcome of this experiment.
7. Apparatus and equipments required for the allotted experiment will be provided by the lab assistants using SOP.
8. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
9. After performing the experiment students will check their readings, calculations from the teacher.
10. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Termwork Assessment

5. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
6. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: III (Mechanical Engineering)
MEC222008 : Engineering Metallurgy Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical :02 hr/week	**01**	**Term Work: 25 Marks** **Oral: 25 Marks**

COURSE CONTENTS

List of Experiments

Sr. No.	Title	CO Mapped
1	Destructive testing - Hardness testing (Rockwell/Vickers) Hardness conversion number	CO1, CO4
2	Brinell hardness Test	CO1, CO4
3	Non Destructive testing - Dye Penetrant Test and Magnetic Particle test	CO1, CO4
4	Non Destructive testing - Ultrasonic Test and Eddy Current Test	CO1, CO4
5	Specimen Preparation for microscopic examination	CO2, CO3
6	Demonstration of Optical Metallurgical microscope	CO2, CO3
7	Observation and Drawing of Microstructure of Steels	CO1, CO2, CO3, CO4, CO5
8	Observation and Drawing of Microstructure of Cast Irons	CO1, CO2, CO3, CO4, CO5
9	Heat Treatment of steels based on relative hardness	CO1, CO2, CO3, CO4, CO5

Guidelines for Lab Assessment

1. There should be continuous assessment for the Laboratory Practical's
2. Assessment must be based on understanding of theory, attentiveness during practical, and understanding.
3. Online evolutions of practical with objective type of Questions
4. Timely submission of journal

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: III (Mechanical Engineering)
MEC222009 : Basic Electronics for Mechanical Engineering Lab

Teaching Scheme:	Credit Scheme:	Examination Scheme:
Practical : 02 hrs./week	03	Term work : 25 Marks Oral : 25 Marks

COURSE CONTENTS

List of Experiments

Sr. No.	Title	CO Mapped
1	Study of A. Active and Passive components B. Printed circuit board	CO1
2	Study of Measuring Instruments	CO2
3	Study and understand use of different digital logic gates	CO1
4	Study and understand the operation of basic sensors	CO1
5	Study of simulation tools Example : Tinker cad	CO1
6	Build and demonstrate basic charging circuit for battery of an electric vehicle	CO1
7	Measurement of Vibration using piezoelectric sensor	CO1, CO2
8	Measurement of speed using Hall effect sensor	CO1, CO2
9	Study and understand operation of Pneumatic components	CO1
10	Case study: Implementation not expected only presentation is expected e.g. suggest simple digital circuit for logical operations on binary numbers.	CO1, CO2

Guidelines for Laboratory Conduction

1. Teacher will brief the given experiment to students its procedure, observations calculation, and outcome of this experiment.
2. Apparatus and equipment's required for the allotted experiment will be provided by the lab assistants using SOP.
3. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
4. After performing the experiment students will check their readings, calculations from the teacher. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, diagram, working principle, procedure, observations, graphs, Calculations, conclusion and questions, if any.

Guidelines for Term work Assessment

1. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
2. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech.
Pattern 2022 Semester: III (Mechanical Engineering)
MEC222010: Geometric Modeling and Production Drawing

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical: 04 hr / week	02	Termwork: 25Marks Practical: 50 Marks

Prerequisite Courses: - Systems in Mechanical Engineering, Engineering Graphics, Engg. Math I & II

Course Objectives:

To understand basic concepts of 3D modeling and to create geometric models and assemblies of simple engineering components. The student should be able to employ their knowledge to create more complicated models.

To read, understand and explain basic Geometric Dimensioning & tolerancing concepts.

To apply various geometric and dimension tolerances based on type of fit

To create engineering drawings, design documentation and use in manufacturing activities.

To ensure that the components of the assembly fit together properly, without excessive clearance or interference.

	Course Outcomes	**Bloom's Level**
CO1	READ the Industrial drawing to understand standard industrial practices.	2-Understanding
CO2	CONSTRUCT solid models, assemblies of real life components using various modeling techniques	3- Apply
CO3	APPLY geometric and dimensional tolerance, surface finish symbols in production drawing	3- Apply
CO4	EVALUATE dimensional tolerance based on type of fit	5 - Evaluate
CO5	READ & ANALYSE industrial drawings with Manual drafting	4 -Analyze

COURSE CONTENTS

Part A

I	Assignment on parametric solid modeling and Surface modeling of a machine component.	(04hrs)	COs Mapped – CO1, CO2

Introduction to parametric solid modeling, Introduction to the CAD software interface, basic drawing tools, sketching techniques, Introduction to 2D sketching techniques, apply/modify constraints and

dimensions, and geometric relations in creating 2D profiles of the machine component, transform the parametric 2-D sketch into a 3D solid, feature operations, Surface modeling of a machine component.			
II	Assembly modeling of the parts modeled in Practical assignment-1 using proper assembly constraint conditions and generation of exploded view for assemblies	(04 hrs)	COs Mapped - CO1, CO2
Assembly modeling – defining relationship between various parts of machine, creation of constraints, generation of exploded view			
III	Generation of production drawings of the parts and assembly with appropriate tolerancing.	(04 hrs)	COs Mapped – CO2, CO3
Production drawing – generation of 2-D sketches from parts and assembly 3-D model, appropriate dimensioning, tolerancing and symbols			
Part B			
I	Calculation of Tolerances based on Type of Fits in Assembly	(06hrs)	COs Mapped – CO4, CO5
Limits, Fits, Dimensional Tolerances, Geometric Tolerances, calculate tolerances based on the type of fit required for an assembly.			
II	Study and reading of Industrial Drawings to understand standard industrial procedure	(06 hrs)	COs Mapped – CO4, CO5
Introduction to ASME Y14.5 – 2009, straightness, perpendicularity, flatness, angularity, roundness, concentricity, cylindricity, runout, profile, true position, parallelism, orientation, GD &T, Surface finish, Welding symbols			

Text Books

1. Bhatt, N. D. and Panchal, V. M., (2014), “Machine Drawing”, Charotar Publishing House Pvt. Ltd, Anand, India, ISBN-13: 978-9385039232

2. Ajeet Siingh, “ Machine Drawing”, Mc Graw Hill Publications, New Delhi 2012

3. Narayana, K. L., Kannaiah, P., Venkata Reddy, K., (2016), “Machine Drawing”, 2nd edition, New Age International Publishers, New Delhi, India, ISBN-13: 978-8122440546

4. Chang, Kuang-Hua, (2015), "e-Design: Computer-Aided Engineering Design", Academic Press, ISBN-13: 978-0123820389

Reference Books

1. Cogorno, G. R., (2020), "Geometric Dimensioning and Tolerancing for Mechanical Design", 3rd edition, McGraw-Hill Education

2. Blokdyk, Gerardus, (2019), "Geometric Dimensioning and Tolerancing: A Complete Guide - 2020 Edition", 5STARCooks

Codes / Handbooks

Standards: ASME Y14.5 – 2018

Standards: ISO/TR 23605:2018, ISO 1101:2017, SP 46, IS 15054(2001)

e resources

1 https://geotol.com/resources/
2 https://www.sae.org/learn/professional-development/gdt

Useful websites / Video
1 https://nptel.ac.in/courses/112/102/112102102/
2 https://nptel.ac.in/courses/112/103/112103019/
3 https://nptel.ac.in/courses/112/106/112106179/
4 https://youtu.be/0IgOapAtauM
5 https://youtu.be/aS9OgYadjpY

	Strength of CO-PO/PSO Mapping															
	PO												PSO			
Strength Of CO	1	2	3	4	5	6	7	8	9	10	11	12	1	2		
CO 1	3	-	-	-	-	-	-	-	2	2	1	2	2	1		
CO 2	3	-	-	-	3	-	-	-	2	2	1	2	2	1		
CO 3	3	-	-	-	3	-	-	-	2	2	1	2	2	1		
CO 4	3	-	-	-	-	-	-	2	2	2	1	2	2	1		
CO 5	3				-	-	-	3	2	2	1	2	2	1		

Guidelines for Tutorial / Termwork Assessment		
Sr. No.	**Components for Termwork Assessment**	**Marks Allotted**
1	Assignment on Geometric Modeling	10
2	Assignment on Production Drawing	10
3	Attendance (Above 95 % : 05 Marks, below 75% : 0 Marks)	5

Analysis of syllabus to justify the autonomy (As applicable)

Sr. No.	Point / Parameter	**Topics Justifying the point**
1	What's different than current university syllabus? Unit wise description.	University syllabus is content wise too descriptive. Current syllabus is mainly focused on practical oriented case studies like modification, optimization of existing products. Group wise mini-projects for preparation of production drawings to manufacture the components.
2	Globally Competent, Locally Relevant	GD & T, DFMA, Production drawing, solid modeling and Assembly of a machine components
3	Employability and Industry need based modules in syllabus	CAD Software's with GD & T features, Production drawing, Design for Manufacturing and safety
4	Innovative Teaching – Learning (Blended Learning, Experiential Learning, P. B.L.)	Experimental Learning- reverse engineering, blog, introduction to 3D printing.
5	Research Component, Innovations, Scope for Patent, Technology Forecasting	Product development, modification, optimization of existing product. DFMA
6	Scope for Entrepreneurship, Start-up and skill development	CAD modeling required for CAE, Generation of production drawings
7	Scope for Alumni Mentorship	GD &T, Design for Manufacturing and safety, Generation of production drawings
8	Scope for Chair Professorship, Adjutant faculty, Expert lectures	GD &T, Generation of production drawings
9	Self-study modules	NPTEL course, YouTube videos, 3D printing
10	Need based / skill based / field and job oriented open electives	-
11	Topics related to industrial training and /or field work for all its	Study and reading of Industrial Drawings , GD &T, Generation of production drawings

	students	
12	Topics related to Cognitive Domain	solid modeling and Assembly of a machine components , GD & T, DFMA, Production drawing,
13	Topics related to Affective Domain	-
14	Topics related to Psychomotor Domain	Assembly of a machine components, GD & T

K. K. Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: III (Mechanical Engineering)
MEC222011: Engineering Thermodynamics

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **In Sem Exam: 20Marks** **End Sem Exam: 60Marks**

Prerequisite Courses, if any: - Engineering Mathematics I and II, Engineering Physics, Calculas

Course Objectives:

- **Course would introduce laws of thermodynamics**
- **Course would introduce the concept of entropy and availability**
- **Course would cover fluid properties and vapour cycles.**
- **Course would cover first law analysis of refrigeration systems and Psychrometry**
- **Course would cover first law analysis of Air Compressor and Steam Generators**

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Apply** the concepts of First Law of Thermodynamics for Steady Flow Systems	3-Apply
CO2	**Apply** the concepts of Entropy and Availability for analysis of open and closed system	3-Apply
CO3	**Estimation** of steam properties and application of first law to power cycle	3-Apply
CO4	**Estimate** performance of refrigeration system and understand Psychrometry	3-Apply
CO5	**Apply** the concepts of First Law of Thermodynamics for Air Compressor and Steam Generators	3-Apply

COURSE CONTENTS

Unit I	**Laws of Thermodynamics**	**(08hrs)**	**COs Mapped - CO1**

First Law of Thermodynamics: Concept of heat and work, Sign convention and its conversion. First law of thermodynamics, Equivalence of heat and work. Application of first law to Steady flow energy equation (SFEE)

Second Law of Thermodynamics: Limitations of first law of thermodynamics, Statement of the Second law of Thermodynamics; PMM-II kind, Clausius Inequality, Carnot Theorem

Unit II	**Entropy and Availability**	**(08hrs)**	**COs Mapped - CO1, CO2**

Entropy: Entropy as a property, Clausius Inequality, Principle of increase of Entropy Principle, Entropy changes for an Open and Closed System, Change of Entropy for an ideal gas and Pure Substance,

Concept of Entropy generation. Entropy - a measure of Disorder.

Availability: Available and Unavailable Energy, Concept of Availability, Availability of heat source at constant temperature and variable temperature, Availability of non-flow and steady-flow Systems.

Unit III	Properties of Working Fluid and Vapour Power Cycle	(10hrs)	COs Mapped - CO1, CO2,CO3

Ideal Gas properties

Ideal Gas definition, Gas Laws: Boyle's law, Charle's law, Avagadro's Law, Equation of State, Ideal Gas constant and Universal Gas constant, Ideal gas Processes- on P-v and T-s diagrams, Constant Pressure, Constant Volume, Isothermal, Adiabatic, Polytropic, Throttling Processes (Open and Closed systems), Calculations of Heat transfer, Work done, Internal Energy, Entropy.

Properties of Pure substances: Formation of steam, Phase changes, Properties of steam, Use of Steam Tables, Study of P-v, T-s and h-s plots (Mollier Chart) for steam, Dryness fraction and its determination, Study of steam calorimeters (Barrel, Separating, Throttling and combined) Non-flow and Steady flow Vapour Processes, Change of Properties, Work and Heat transfer.

Vapour Power Cycle: Thermodynamic Cycle: Carnot Cycle, Rankine Cycle, Comparison of Carnot cycle and Rankine cycle.

Unit IV	First Law Analysis of Refrigeration System and Psychrometry	(09hrs)	COs Mapped - CO1, CO4

Refrigeration System: Schematic of mechanical refrigeration system, SFEE of components of refrigeration system, Thermodynamic Refrigeration Cycle representation of vapour compression cycle (VCC) on T-s and P-h diagram, Performance Analysis of VCC

Psychrometry: Introduction, Psychrometry and Psychrometric Properties, Basic Terminologies & Psychrometric Relations, Psychrometric Processes, Psychrometric Chart.

Unit V	Air Compressor and Steam Generators	(09hrs)	COs Mapped - CO1,CO5

Reciprocating Compressor: Applications of compressed air, single stage compressor (without clearance and with clearance volume), volumetric efficiency, isothermal efficiency, effect of clearance volume, free air delivery (FAD), actual indicator diagram for air compressor, Multi staging of compressor, optimum intermediate pressure, intercooler, after cooler, Capacity control of compressors.

Steam Generators: Classification, Constructional details of low pressure boilers, Boiler mountings and accessories, Instrumentations required for safe and efficient operation, Introduction to IBR Act

Text Books

R. K. Rajput, Engineering Thermodynamics, EVSS Thermo Laxmi Publications

P. K. Nag, Engineering Thermodynamics, Tata McGraw Hill Publications

Reference Books

Y. Cengel & Boles: Thermodynamics – An Engineering Approach,

P. L Ballany: Thermal Engineering, Khanna Publishers

C.P. Arora: Engineering Thermodynamics, Tata McGraw Hill.

S. Domkundwar, C. P. Kothandaraman, and Domkundwar, Thermal Engineering, Dhanpat Rai Publishers.

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	2	-	1	-	-	-	-	1	-	-	1
CO2	3	2	-	1	-	-	-	-	1	-	-	1
CO3	3	2	-	1	-	-	-	-	1	-	-	1
CO4	3	2	-	1	-	-	-	-	1	-	-	1
CO5	3	-	-	-	-	-	1		1			1
Average	3	2	-	1	-	-	1	-	1	-	-	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	One Assignments on Unit-1, Unit-2, Unit-3, Unit-4 & Unit-5	10
2	Class Test	05
3	LearniCo Test on Each Unit	05
	Total	**20**

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: IV (Mechanical Engineering)
MEC222012: Theory of Machines

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any: - Fundamentals of Mechanical Engineering, Engineering Mechanics, Engineering Mathematics I & II, Engineering physics

Course Objectives:

. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
. To develop the competency to analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
. To develop the skill to propose and synthesize the mechanisms using graphical and analytical technique.
. To develop the competency to understand & apply the principles of gear theory to design various applications.
To develop the competency to design a cam profile for various follower motions.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**IDENTIFY** mechanisms in real life applications	2-Understand
CO2	**CALCULATE** velocity and acceleration in mechanisms by analytical and graphical method	3-Apply
CO3	**CONSTRUCT** a four bar mechanism with analytical and graphical methods	3-Apply
CO4	**APPLY** fundamentals of gear theory as a prerequisite for gear design	3-Apply
CO5	**CONSTRUCT** cam profile for given follower motion	3-Apply

COURSE CONTENTS

Unit I	**Fundamentals of Mechanisms**	**(08hrs)**	**COs Mapped - CO1**

Introduction, Mechanism and machine, Link, Kinematic pair, Types of motion, Degrees of freedom (mobility), Classification of kinematic pairs, Kinematic chain, Linkage, Mechanisms, Grashoff's law, Kinematic inversion, Inversions of slider crank chain, Double slider-crank chain

Unit II	**Kinematic Analysis of Planar Mechanisms:**	**(08hrs)**	**COs Mapped - CO1, CO2**

Kinematic Analysis of Planar Mechanisms: Graphical methods for the velocity and acceleration analysis of four bar, slider crank and other single degree of freedom mechanisms by relative velocity method and ICR method. Kinematic analysis of slider crank Mechanism by analytical method, Velocity and acceleration analysis of Four-Bar and Slider crank mechanisms using Complex Algebra Method.

Unit III	Synthesis of Mechanisms	(08hrs)	COs Mapped - CO1, CO3

Steps in Synthesis: Type synthesis, Number Synthesis, Dimensional synthesis, Tasks of Kinematic synthesis - Path, function and motion generation (Body guidance), Precision Positions, Chebychev spacing, Mechanical and structural errors

Graphical Synthesis: Inversion and relative pole method for three position synthesis of Four-Bar and Single Slider Crank Mechanisms

Analytical Synthesis: Three position synthesis of Four-Bar mechanism using Freudenstein's equation

Unit IV	Gears and Gear trains	(08hrs)	COs Mapped - CO1, CO4

Classification, Terminology, Law of Gearing, Interference and methods to avoid interference in spur gears. Simple, compound, reverted and epicyclic gear trains.

Unit V	Cams & Followers	(08hrs)	COs Mapped - CO1, CO5

Classification of Followers and Cams, Terminology of Cam Displacement diagram for the Motion of follower as Uniform velocity, Simple Harmonic Motion (SHM), Uniform Acceleration and Retardation Motion (UARM), Cycloid motion, Cam Profile construction for Knife-edge Follower and Roller Follower, Cam jump Phenomenon

Text Books

. 1. S. S. Rattan, "Theory of Machines", Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
. 2. Bevan T, "Theory of Machines", Third Edition, Longman Publication
. 3. G. Ambekar, "Mechanism and Machine Theory", PHI
. 4. J. J. Uicker, G. R. Pennock, J. E. Shigley, "Theory of Machines and Mechanisms", Fifth Edition, International Student Edition, Oxford
.

Reference Books

1. Paul E. Sandin, "Robot Mechanisms and Mechanical Devices Illustrated", Tata McGraw Hill Publication
2. Stephen J. Derby, "Design of Automatic Machinery", 2005, Marcel Dekker, New York
3. Neil Sclater, "Mechanisms and Mechanical Devices Sourcebook", Fifth Edition, Tata McGraw Hill Publication 4. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
. 5. Hannah and Stephans, "Mechanics of Machines", Edward Arnolde Publication
. 6. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi
. 7. Sadhu Singh, "Theory of Machines", Pearson
. 8. Dr. V. P. Singh, "Theory of Machine", Dhanpatrai and Sons
. 9. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI
.

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	2	2	1	-	-	-	2	-	-	1
CO2	3	3	2	2	-	-	-	-	2	-	-	1
CO3	3	2	-	2	1	-	-	-	1	-	-	1
CO4	3	3	2	2	-	-	-	-	1	-	-	2
CO5	3	2	2	2	1	-	-	-	2	-	-	2
Average	3	3	2	2	1	-	-	-	2	-	-	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Three Assignments on unit-1, Unit-2, Unit-3 & 4	05
2	Group Presentation on Unit-1	10
3	LearniCo Test on Each Unit	05
	Total	**20**

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	To make a model of any mechanism by the group of 4 students and to give a presentation using PPTs.	**CO1**
2	Identify mechanisms in real life and Analyze for types and number of links, pairs, obtain degrees of freedom.	**CO1**
3	To design a simple Planar Mechanism by using any software	**CO1**
4	To solve two problems on velocity and acceleration analysis using relative velocity and acceleration method.	**CO1, CO2**
5	To solve two problems on velocity analysis using the ICR method.	**CO1, CO2**
6	To do computer programming for Kinematic Analysis of Slider Crank Mechanism using Analytical Method by using software/programming languages like C, Python, Scilab, Matlab etc	**CO1, CO2**
7	To synthesize the four bar and slider crank mechanism using relative pole and inversion method with three accuracy points.	**CO1, CO3**
8	To study manufacturing of gear using gear generation with rack as a cutter and to generate an involute profile.	**CO1, CO4**
9	Speed and torque analysis of epicyclic gear train to determine holding torque.	**CO1, CO4**
10	To draw cam profile for any two problems with combination of various follower motion with radial and off-set cam and manufacturing by using laser cutting machine	**CO1, CO5**
11	To study and verify cam jump phenomenon.	**CO1, CO5**

Guidelines for Laboratory Conduction

11. Teacher will brief the given experiment to students its procedure, observations calculation, and outcome of this experiment.
12. Apparatus and equipment's required for the allotted experiment will be provided by the lab assistants using SOP.
13. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
14. After performing the experiment students will check their readings, calculations from the teacher.
15. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Termwork Assessment

7. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
8. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech.
Pattern 2022 Semester: IV (Mechanical Engineering)
MEC222013: Mechanics of Materials

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any: - Engineering Mechanics, Mathematics I & II, Fundamentals of Mechanical Engineering

Course Objectives :

18. Understand the various types of stresses in machine members
19. Understand the beam theory with various load and support conditions
20. Understand the concept of complex stresses and theories of failure
21. Understand the torsion and combined loading problems

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Use** the concepts of simple stresses, strains, in the analysis of machine members and structures.	3 - Apply
CO2	**Analyze** the transversely loaded beams with various Load and support conditions.	3 - Apply
CO3	**Apply** the concept of principal stresses and theories of failure to determine stresses on a 2-D element.	3 - Apply
CO4	**Utilize** the torsion and solve combined loading application based problems.	4 - Analyze

COURSE CONTENTS

Unit I	**Simple stresses and strains,**	**(08hrs)**	**COs Mapped - CO1**

Overview of Material Properties, Bulk Modulus. Interrelation between elastic constants, factor of safety, Stresses and strains in determinate and indeterminate structures, homogeneous and composite bars under concentrated loads and self-weight. Thermal stresses

Unit II	**Shear Force and Bending Moment Diagrams, Stresses in Machine Elements**	**(08hrs)**	**COs Mapped - CO2**

Shear force and bending moment diagrams for Simply supported & Cantilever beams for Point load, UVL, UDL & Couple, Maximum bending moment and position of points of contra flexure.

Stresses in Machine Elements

Bending stresses : Theory of simple bending, flexural formula,

Shear stresses: Shear stress distribution formula & distribution diagrams for common symmetrical sections

Unit III	**Slope and deflection of beams & Buckling of columns**	**(08hrs)**	**COs Mapped - CO1, CO2**

Slope and deflection of determinate beams, Macaulay's method, slope and deflection for standard cases.

Buckling of columns: Euler's formula, Rankine's formula, safe load on columns

Unit IV	Principal stresses and strains , Theories of elastic failure,	(08hrs)	COs Mapped - CO3
Normal and shear stresses on any oblique plane, Expression for principal stresses and maximum shear stress, position of principal planes and planes of maximum shear. Graphical solution using Mohr's circle of stresses. **Theories of elastic failure:** Maximum principal stress theory, maximum shear stress theory, maximum distortion energy theory – their applications and limitations.			
Unit V	**Torsion, Strain energy and Combined Loading**	**(08hrs)**	**COs Mapped - CO1, CO4**
Torsion equation, Stresses, strain and deformations in determinate shafts of solid and hollow, homogeneous and composite circular cross section subjected to twisting moment, Strain energy: Strain energy due to axial load , shear, bending and torsion, Concept of equivalent torsional and bending moments, Combined problem of Normal and Shear type of Stresses.			

Text Books

1. R. K. Bansal, "Strength of Materials", Laxmi Publication
2. S. Ramamrutham, "Strength of material", Dhanpat Rai Publication
3. S.S. Rattan, "Strength of Material", Tata McGraw Hill Publication Co. Ltd.
4. Punmia and Jain, " Mechanics of Materials", Laxmi publications
5. Singer and Pytel, "Strength of materials", Harper and row Publication
6. R. C. Hibbeler, "Mechanics of Materials", Prentice Hall Publication

Reference Books

1. Egor. P. Popov, "Introduction to Mechanics of Solids", Prentice Hall Publication
2. Gere and Timoshenko, " Mechanics of Materials",CBS Publishers
3. Beer and Johnston, "Strength of materials", CBS Publication
4. James M. Gere, "Mechanics of Materials", CL Engineering
5. Timoshenko and Young, "Strength of Materials", CBS Publication, Singapore

Strength of CO-PO/PSO Mapping

	PO												PSO	
CO	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	**2**	**1**	**1**	**2**	**-**	**1**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**-**
CO 2	**2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**-**
CO 3	**2**	**2**	**2**	**1**	**2**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**-**
CO 4	**2**	**2**	**2**	**1**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**2**	**2**	**-**

Guidelines for Continuous Comprehensive Evaluation of Theory Course

Sr. No.	Components for Continuous Comprehensive Evaluation	Marks Allotted
1	One Assignment on each unit	10

2	Class Test	05
3	LearniCo Test on Each Unit	05
	Total	**20**

List of Laboratory Experiments / Assignments		
Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Tension test for Ductile material.	CO1
2	Compression test for Brittle / Ductile material.	CO1
3	Shear test of ductile material	CO1
4	Experimental verification of torsion formula for circular bar	CO1
5	Experimental verification of flexural formula in bending for cantilever / Simple supported beam	CO1, 2
6	Fatigue test on metallic materials	CO1
7	Graphical simulation of - (using suitable software like MD-Solids, Matlab, MS-Excel etc.) Shear force and bending moment diagrams with different end conditions	CO3
8	Principal stresses through analytical and graphical method	CO3
9	Self-learning study practical: Following topics are distributed among the group of 3-5 Students and groups need to present and also submit the slides/poster on TW file. a. Experimental stress analysis, Strain Gauges rosette with case study. b. Residual stresses and Fatigue life with case study. c. Mechanical properties of materials, Stresses and Design of components with case study. d. Failure Mode Analysis and Stresses with case study. e. Continuous Beams with 3 Reactions problem, Area Moment Calculation	CO4

Guidelines for Laboratory Conduction

16. Teacher will brief the given experiment to students its procedure, observations calculation, and outcome of this experiment.
17. Apparatus and equipments required for the allotted experiment will be provided by the lab assistants using SOP.
18. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
19. After performing the experiment students will check their readings, calculations from the teacher.
20. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Termwork Assessment

9. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
10. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech.
Pattern 2022 Semester: IV (Mechanical Engineering)
MEC222014: Electric and Hybrid Vehicles

Teaching Scheme	Credit Scheme	Examination Scheme
Theory : 03 hrs/week	**03**	**Continuous Comprehensive Evaluation : 20 Marks** **InSem Exam : 20 Marks** **EndSem Exam : 60 Marks**

Prerequisite Courses, if any:

Course Objectives:

. To understand the basics of electric and hybrid vehicle technology and various configurations
. To analyze ideal cycle used in engines and evaluate various performance parameters of engines
. To compare combustion and identify appropriate emission control technologies in SI and CI engines
. To understand components and technologies used in electrical and hybrid electric vehicles

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	Bloom's Level
CO1	**Explain** basics of IC engines, electric and hybrid technology in vehicles	2-understand
CO2	**Analyze** air standard cycles, **Evaluate** various performance parameters of engines	4- Analyze
CO3	**Compare** combustion and **identify** appropriate emission control technologies in SI and CI engines	2-Understand
CO4	**Understand** and **Compare** EV, HEV and Internal combustion engine technologies based on net energy analysis	2-Understand

COURSE CONTENTS

Unit I	**Introduction to Electric and Hybrid vehicles**	**(06 hrs)**	**COs Mapped – CO1**
Basics of IC engines, working of engines, Electric vehicle fundamentals, basics of hybrid electric vehicles, climate change context, net energy analysis of electric vehicles			
Unit II	**Engine cycles, Systems and Testing**	**(08 hrs)**	**COs Mapped - CO2**
Air standard cycles (Air standard cycles, Fuel air cycles, and actual cycle), Engine systems, Performance parameters, Testing of engines			
Unit III	**Combustion and Emission control in Engines**	**(08 hrs)**	**COs Mapped – CO3**
Combustion in SI and CI engines, advanced technologies for improving combustion process (MPFI, GDI, HCCI, Stratified charge, CRI, Turbocharging) Pollutants, Phenomenon of formation, Emission norms (Bharat and Euro standards), Emission control technologies, Use of alternate fuels such as Ethanol, Methanol, CNG, Biodiesel, Hydrogen, Fuel additives			
Unit IV	**Electric Vehicles**	**(08 hrs)**	**COs Mapped – CO1, CO4**
Performance of Electric Vehicles, Motors, Traction Motor Characteristics and comparison with engines performance characteristics, Batteries, Battery sizing calculation, Battery management, Effect on carbon emissions			

Unit V	Hybrid Electric Vehicles	(08 hrs)	COs Mapped – CO1, CO4
Series Hybrid Electric Drive Trains, Parallel Hybrid Electric Drive Trains, Torque-Coupling, Parallel Hybrid Electric Drive Trains, Speed-Coupling Parallel Hybrid Electric Drive Trains, Torque-Coupling and Speed-Coupling Parallel Hybrid Electric Drive Trains			

Text Books

1. IC Engines (Combustion and Emissions) by B. P. Pundir, Narosa Publications
2. Internal combustion engine by Mathur M. L. and Sharma R. P., DhanpatRai publications
3. Internal combustion engines by V. Ganesan, Tata McGraw Hill

Reference Books

16. Engine Emissions: Pollutant Formation and Advances in Control Technology by B. P. Pundir, Alpha science publication
17. Internal combustion engine Fundamentals by John B. Heywood, McGraw Hill
18. Electric vehicle technology by James Larminie and John Lowry, Wiley Publication
19. Electric and Hybrid Vehicles by Tom Denton, Routledge (Taylor and Francis group)
20. Hybrid Electric Vehicle Design and Control: Intelligent Omnidirectional Hybrids by Y. Xu, J Yan, H Qian, T lam, McGraw Hill

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	**3**	**3**	**1**	**-**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**2**
CO2	**3**	**3**	**3**	**3**	**1**	**2**	**2**	**1**	**2**	**-**	**-**	**2**
CO3	**3**	**2**	**2**	**-**	**1**	**2**	**2**	**1**	**-**	**-**	**-**	**2**
CO4	**3**	**2**	**2**	**1**	**-**	**2**	**2**	**1**	**-**	**-**	**-**	**2**
Average	**3**	**3**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**-**	**-**	**2**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	One assignment on each unit	15
3	LearniCo Test on Each Unit	05
	Total	**20**

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S. Y. B. Tech.
Pattern 2022 Semester: IV (Mechanical Engineering)
MEC222015:Economics for Sustainability

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :03 hrs/week	**03**	**Continuous Comprehensive Evaluation: 20Marks** **InSem Exam: 20Marks** **EndSem Exam: 60Marks**

Prerequisite Courses, if any:

Course Objectives:

. 1.To expose the students to environmental problems and concept of sustainable development
. 2. To explain the concepts of carbon footprint and its calculations.
. 3.To train the students to analyze environmental damage
. 4.To help students internalize the tools needed for the evaluation of projects such as cost-benefit analysis, and environmental impact
.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Explain** environmental questions both local and global and limitations of applying economic principles to environment questions	2-understand
CO2	**Calculate** carbon footprint and develop broader understanding of economics of climate change	4- Analyze
CO3	**Analyze** environment policy issues like environmental damage using cost benefit analysis	4- Analyze
CO4	**Design** environmental policy for local environmental problems and understand the design and implementation of international environment policy	5- Create

COURSE CONTENTS

Unit I	**Introduction to Sustainable development**	**(06 hrs)**	**COs Mapped – CO1**
Introduction to Sustainable development, concepts, sustainable development goals			
Unit II	**Environmental Issues**	**(08 hrs)**	**COs Mapped – CO1 and CO2**
Overview of environmental problems in the world. Climate change .International agreements Overview of environmental problems of India, Carbon footprint			
Unit III	**Externalities**	**(08 hrs)**	**COs Mapped – CO1,CO3**
The theory of externalities: Pareto optimality and market failure in the presence of externalities; property rights and the Coase theorem			
Unit IV	**Environmental policies**	**(08 hrs)**	**COs Mapped – CO1,CO3, CO4**
The design and implementation of environmental policy: overview; Pigouvian taxes and effluent fees; tradable permits; choice between taxes and quotas under uncertainty; implementation of environmental policy			
Unit V	**Measuring Environmental Impacts**	**(08 hrs)**	**COs Mapped – CO1, CO4**

International environmental problems: trans-boundary environmental problems; economics of climate change; trade and environment. Measuring the benefits of environmental improvements: non-market values and measurement methods; risk assessment and perception

Text Books

4. Kolstad, C. (2010). Intermediate environmental economics, 2nd ed. Oxford University Press.

2. Stephen Smith (2011) Environmental Economics: A Very Short Introduction ,Oxford University Press

Reference Books/Literature

1 This Changes Everything: Capitalism vs. the Climate by Naomi Klein
2. Cropper, M., Oates, W. (1992). Environmental economics: A survey, Journal of Economic Literature, 30, 675-740.
3. Heal, G. (2012). Reflections – defining and measuring sustainability. Review of Environmental Economics and Policy, 6, 147-163.
4. Newell, R., Pizer, W., Raimi, D. (2013). Carbon markets 15 years after Kyoto: Lessons learned, new challenges. Journal of Economic Perspectives, 27, 123- 46.
5. Perman, R., Ma, Y., McGilvray, J., Common, M. (2011). Natural resource and environmental economics, 3rd ed. Pearson Education/Addison Wesley.
6. Stavins, R. (ed.) (2012). Economics of the environment: Selected readings, 5th ed. W. W. Norton.

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	**2**	**2**	**1**	**-**	**-**	**3**	**3**	**1**	**2**	**2**	**-**	**2**
CO2	**2**	**2**	**2**	**2**	**1**	**2**	**3**	**1**	**2**	**2**	**2**	**2**
CO3	**2**	**2**	**2**	**2**	**1**	**2**	**3**	**1**	**2**	**2**	**2**	**2**
CO4	**2**	**2**	**2**	**2**	**-**	**2**	**3**	**1**	**2**	**2**	**2**	**2**
Average	**2**	**2**	**2**	**2**	**1**	**2**	**2**	**1**	**2**	**2**	**2**	**2**

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	One assignment on each unit	15
3	LearniCo Test on Each Unit	05
	Total	**20**

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S. Y. B. Tech.

Pattern 2022 Semester: III (Mechanical Engineering)

MEC222016: Design Thinking

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Theory :-- 1 hr / Week	--	--

Prerequisite Courses: - Engineering drawing, Engineering exploration, Workshop practice

Course Objectives:

To provide the new ways of thinking in creative manner.

To learn Design Thinking Process for developing innovative products.

To prepare students for an engineering career from product design prospective.

To inculcate teamwork and leadership skills among students.

	Course Outcomes	**Bloom's Level**
CO1	**Identify** various learning skills and memory techniques and its applications.	2
CO2	**Describe** a visual representation of an idea	2
CO3	**Select** appropriate frameworks, strategies, techniques during prototype development	2

COURSE CONTENTS

Unit No	**Unit Name**	**Duration (hrs)**	**COs Mapping**
I	**Fundamentals of Design Thinking**	**03**	**CO1, CO2**
Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts and Brainstorming, Stages of Design Thinking Process – Empathize, Define, Ideate, Prototype, Test			
II	**Product Design Process**	**03**	**CO1, CO2, CO3**
Process of Product Design, Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design			
III	**Creative thinking**	**03**	**CO1, CO2, CO3**
Understanding Creative thinking process, Understanding Problem Solving and Creative			

Problem Solving			
IV	**Prototype and its requirements**	**03**	**CO1, CO2, CO3**
What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example/Simple case study			

Text Books
1. E Balaguruswamy (2022), Developing Thinking Skills (The way to Success), Khanna Book Publishing Company. 2. Pavan Soni, "Design Your Thinking: The Mindsets, Toolsets & Skill Sets For Creative Problem-solving", Penguin Random House India.
Reference Books
1. Gavin Ambrose and Paul Harris, "Design Thinking", Bloomsbury Publication.

CO-PO Mapping

CO	**PO**												**PSO**	
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**
CO 1	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**
CO 2	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**
CO 3	**3**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**

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S. Y. B. Tech.
Pattern 2022 Semester: IV (Mechanical Engineering)
MEC222017: Thermal Engineering Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical :02 hrs/week	**02**	**Termwork: 25 marks** **Practical Exam: 50marks**

Prerequisite Courses, if any: - Basic Thermodynamics and I. C. Engines

Course Objectives:

. To apply energy analysis for steam generator
. To evaluate the performance of refrigeration and air conditioning system
. To evaluate the performance of engines and compressor
. To diagnose engine combustion through emission measurement

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Apply** first law of thermodynamics to thermal systems	3-Apply
CO2	**Evaluate** various performance parameters of thermal systems through experimentation and using software	4- Analyze
CO3	**Diagnose** engine combustion through emission measurement	2-Understand
CO4	**Analyze** and**Compare** various systems from energy and environmental perspective	4- Analyze

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Analysis of Boiler from any industry	CO1, CO2
2	Trial on Separating and throttling calorimeter	CO1
3	Trial on Vapour Compression System	CO1, CO2
4	Trial on Air-Conditioning Test Rig	CO1, CO2
5	Trial on Air Compressor	CO1, CO2
6	Trial on engine to obtain performance parameters and heat balance sheet at different loads	CO1, CO2
7	Trial on engine to study the effect of variable compression ratio	CO4
8	Demonstration on Exhaust Gas Analyzer	CO3
9	Case study on thermal systems (Assignment and Presentation)	CO1, CO2, CO4
10	Analysis of any thermal system using programming software (Assignment)	CO1, CO2, CO4

Guidelines for Laboratory Conduction

21. Teacher will brief the given experiment to students its procedure, observations calculation, and outcome of this experiment.
22. Apparatus and equipment's required for the allotted experiment will be provided by the

lab assistants using SOP.

23. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
24. After performing the experiment students will check their readings, calculations from the teacher.
25. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, setupdiagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Termwork Assessment

11. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
12. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

Strength of CO-PO Mapping

	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	**3**	**3**	**3**	**2**	**1**	**2**	**1**	**1**	**3**	**2**	**2**	**2**
CO2	**3**	**3**	**3**	**3**	**2**	**2**	**1**	**1**	**3**	**2**	**2**	**2**
CO3	**3**	**2**	**2**	**1**	**1**	**3**	**3**	**1**	**3**	**2**	**2**	**2**
CO4	**3**	**3**	**3**	**3**	**2**	**3**	**3**	**1**	**3**	**2**	**2**	**2**
Average	**3**	**2**	**2**	**2**	**2**	**3**	**2**	**1**	**3**	**2**	**2**	**2**

K.K.Wagh Institute of Engineering Education and Research, Nashik
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S. Y. B. Tech.
Pattern 2022 Semester: IV (Mechanical Engineering)
MEC222018: Theory of Machines Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term Work: 25Marks** **Oral: 25Marks**

Prerequisite Courses, if any: - Fundamentals of Mechanical Engineering, Engineering Mechanics, Engineering Mathematics I & II, Engineering physics

Course Objectives:

. To make the students conversant with kinematic analysis of mechanisms applied to real life and industrial applications.
. To develop the competency to analyze the velocity and acceleration in mechanisms using analytical and graphical approach.
. To develop the skill to propose and synthesize the mechanisms using graphical and analytical technique.
. To develop the competency to understand & apply the principles of gear theory to design various applications.
To develop the competency to design a cam profile for various follower motions.

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**IDENTIFY** mechanisms in real life applications	2-Understand
CO2	**CALCULATE** velocity and acceleration in mechanisms by analytical and graphical method	3-Apply
CO3	**CONSTRUCT** a four bar mechanism with analytical and graphical methods	3-Apply
CO4	**APPLY** fundamentals of gear theory as a prerequisite for gear design	3-Apply
CO5	**CONSTRUCT** cam profile for given follower motion	3-Apply

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	To make a model of any mechanism by the group of 4 students and to give a presentation using PPTs.	**CO1**
2	Identify mechanisms in real life and Analyze for types and number of links, pairs, obtain degrees of freedom.	**CO1**
3	To solve two numerical on velocity and acceleration analysis using relative velocity and acceleration method.	**CO1, CO2**
4	To solve two numerical on velocity analysis using the ICR method.	**CO1, CO2**
5	Kinematic Analysis of Slider Crank Mechanism using Analytical Method by using software/programming languages.	**CO1, CO2**
6	To synthesize the four bar and slider crank mechanism using relative pole and inversion method with three accuracy points.	**CO1, CO3**
7	To study manufacturing of gear using gear generation with rack as a	**CO1, CO4**

	cutter and to generate an involute profile.	
8	Speed and torque analysis of Epicyclic gear train to determine holding torque.	**CO1, CO4**
9	To draw cam profile for any two problems with combination of various follower motion with radial and off-set cam and manufacturing by using laser cutting machine	**CO1, CO5**
10	To study and verify cam jump phenomenon.	**CO1, CO5**

Guidelines for Laboratory Conduction

26. Teacher will brief the given experiment to students its procedure, observations calculation, and outcome of this experiment.
27. Apparatus and equipment's required for the allotted experiment will be provided by the lab assistants using SOP.
28. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
29. After performing the experiment students will check their readings, calculations from the teacher.
30. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, and diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Term work Assessment

13. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
14. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

Text Books

. 1. S. S. Rattan, "Theory of Machines", Third Edition, McGraw Hill Education (India) Pvt. Ltd., New Delhi.
. 2. Bevan T, "Theory of Machines", Third Edition, Longman Publication
. 3. G. Ambekar, "Mechanism and Machine Theory", PHI
. 4. J. J. Uicker, G. R. Pennock, J. E. Shigley, "Theory of Machines and Mechanisms", Fifth Edition, International Student Edition, Oxford
.

Reference Books

. 1. Paul E. Sandin, "Robot Mechanisms and Mechanical Devices Illustrated", Tata McGraw Hill Publication
. 2. Stephen J. Derby, "Design of Automatic Machinery", 2005, Marcel Dekker, New York
. 3. Neil Sclater, "Mechanisms and Mechanical Devices Sourcebook", Fifth Edition, Tata McGraw Hill Publication 4. Ghosh Malik, "Theory of Mechanism and Machines", East-West Pvt. Ltd.
. 5. Hannah and Stephans, "Mechanics of Machines", Edward Arnolde Publication
. 6. R. L. Norton, "Kinematics and Dynamics of Machinery", First Edition, McGraw Hill Education (India) P Ltd. New Delhi
. 7. Sadhu Singh, "Theory of Machines", Pearson
. 8. Dr. V. P. Singh, "Theory of Machine", Dhanpatrai and Sons
. 9. C. S. Sharma & Kamlesh Purohit, "Theory of Machine and Mechanism", PHI
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Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	3	2	2	1	-	-	-	2	-	-	1
CO2	3	3	2	2	-	-	-	-	2	-	-	1
CO3	3	2	-	2	1	-	-	-	1	-	-	1
CO4	3	3	2	2	-	-	-	-	1	-	-	2
CO5	3	2	2	2	1	-	-	-	2	-	-	2
Average	3	3	2	2	1	-	-	-	2	-	-	1

Guidelines for Continuous Comprehensive Evaluation of Theory Course		
Sr. No.	**Components for Continuous Comprehensive Evaluation**	**Marks Allotted**
1	Three Assignments on unit-1, Unit-2, Unit-3 & 4	05
2	Group Presentation on Unit-1	10
3	LearniCo Test on Each Unit	05
	Total	**20**

K. K. Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech.
Pattern 2022 Semester: IV (Mechanical Engineering)
MEC222019: Mechanics of Materials Lab

Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical : 02 hrs/week	**01**	**Term Work: 25 Marks** **Oral: 25 Marks**

Prerequisite Courses, if any: - Engineering Mechanics, Mathematics I & II, Fundamentals of Mechanical Engineering

Course Objectives :

39. Understand the various types of stresses in machine members
40. Understand the beam theory with various load and support conditions
41. Understand the concept of complex stresses and theories of failure
42. Understand the torsion and combined loading problems

Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Use** the concepts of simple stresses, strains, in the analysis of machine members and structures.	3 - Apply
CO2	**Analyze** the transversely loaded beams with various Load and support conditions.	3 - Apply
CO3	**Apply** the concept of principal stresses and theories of failure to determine stresses on a 2-D element.	3 - Apply
CO4	**Utilize** the torsion and solve combined loading application based problems.	4 - Analyze

List of Laboratory Experiments / Assignments

Sr. No.	**Laboratory Experiments / Assignments**	**CO Mapped**
1	Tension test for Ductile material.	CO1
2	Compression test for Brittle / Ductile material.	CO1
3	Shear test of ductile material	CO1
4	Experimental verification of torsion formula for circular bar	CO1
5	Experimental verification of flexural formula in bending for cantilever / Simple supported beam	CO1, 2
6	Fatigue test on metallic materials	CO1
7	Graphical simulation of - (using suitable software like MD-Solids, Matlab, MS-Excel etc.) Shear force and bending moment diagrams with different end conditions	CO3
8	Principal stresses through analytical and graphical method	CO3
9	Self-learning study practical: Following topics are distributed among the group of 3-5 Students and groups need to present and also submit the	CO4

	slides/poster on TW file. f. Experimental stress analysis, Strain Gauges rosette with case study. g. Residual stresses and Fatigue life with case study. h. Mechanical properties of materials, Stresses and Design of components with case study. i. Failure Mode Analysis and Stresses with case study. j. Continuous Beams with 3 Reactions problem, Area Moment Calculation	

Guidelines for Laboratory Conduction

31. Teacher will brief the given experiment to students its procedure, observations calculation, and outcome of this experiment.
32. Apparatus and equipments required for the allotted experiment will be provided by the lab assistants using SOP.
33. Students will perform the allotted experiment in a group (two students in each group) under the supervision of faculty and lab assistant.
34. After performing the experiment students will check their readings, calculations from the teacher.
35. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, diagram, working principle, procedure, observations, graphs, calculations, conclusion and questions, if any.

Guidelines for Laboratory Assessment

15. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
16. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.

K.K.Wagh Institute of Engineering Education and Research, Nashik
(Autonomous from Academic Year 2022-23)

S. Y. B. Tech. **Pattern 2022 Semester: III (Mechanical Engineering)** **MEC222020: IDEA Lab Workshop**		
Teaching Scheme:	**Credit Scheme:**	**Examination Scheme:**
Practical :04 hrs/week	**01**	**Term work: 50 Marks**

Prerequisite Courses: - Basic Mechanical Engineering, Basic Electronics Engineering, Engineering Drawing,

Course Objectives:

1. To learn all the skills associated with the tools and inventory associated with the IDEA Lab.
2. Learn useful mechanical and electronic fabrication processes.
3. Learn necessary skills to build useful and standalone system/ project with enclosures.
4. Learn necessary skills to create print and electronic documentation for the system/project

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Course Outcomes: On completion of the course, students will be able to–

	Course Outcomes	**Bloom's Level**
CO1	**Classify** the tools for measurement of dimension/ electric value	2- Understanding
CO2	**Summaries** the different type of weld joint and its application	2- Understanding
CO3	**Development** of product by using machine operation (laser cutting or wood lathe machine)	3- Apply
CO4	**Construct** the electronic programmefor different application by using Arduino	3- Apply
CO5	**Make use of** different machining processes for achieve the surface roughness value of product surface.	3- Apply

COURSE CONTENTS

	Description
1	Introduction of basic electronics component used in automization Arduino, ESP32 microcontroller, Relay module, Battery pack, sensors
2	Familiarization and use of basic measurement tools and linkage for automization Auto CAD, Design Software, Multi meter, 3D scanner, dimension measurement, linkage mechanism(linear and rotary)
3	Building the electronic circuit including basic sensor and Arduino Building various linkage by using laser cutting machine and 3D printer
4	Development of mini project based on above contents
5	Report writing and presentation Documentation, Simulation, Video.

LABORATORY ACTIVITIES:

Sr. No.	List of Lab activities and experiments
1	Measurement of dimension of any mechanical device by using 3D scanner or another measurement tool and create a production drawing including fits and tolerance. Example: Hand mixture, Electric switch, Crank shaft assembly, Ceiling fan, Bearing puller etc.
2	Study the different types of welding joints and prepare joint by using any welding machine
3	Development of mechanical linkages for any application by using CAD software, manufacture it by using Laser cutter (Cutting & engrave process) and assemble it. (Example: Umbrella mechanism, Bed folding mechanism, Agriculture machine linkage, Folding ladder linkage etc.) Use of plywood, Acrylic, MDF board etc.
3	Design and fabricate the PCB for a suitable circuit using CNC machine and validate the circuit, (Example: Automobile Light On/Off circuit based on light intensity, Number of Cycle count circuit, DC motor On/Off circuit for series/parallel connection etc.)
4	Familiarity and use of normal and wood lathe Create a design for door and use Router machine for its cutting/preparation.
5	Embedded programming using Arduino Example: Traffic signal operation, Water tank level indicator and pump On/Off, Bottle filling programme, etc.)
6	To verify the different various surface finishes achieved by various machine operation and measure the value as per Ra/RMS rule.

TEST BOOK/ REFERENCE BOOK

S. No.	Title
1.	AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual), ISBN: 978-9391505332
2.	All-in-One Electronics Simplified, A.K. Maini; 2021. ISBN-13: 978-9386173393, Khanna Book Publishing Company, New Delhi.
3.	Simplified Q&A - Data Science with Artificial Intelligence, Machine Learning and Deep Learning, Rajiv Chopra, ISBN: 978-9355380821, Khanna Book Publishing Company, New Delhi.
4.	3D Printing & Design, Dr. Sabrie Soloman, ISBN: 978-9386173768, Khanna Book Publishing Company, New Delhi.
5.	The Big Book of Maker Skills: Tools & Techniques for Building Great Tech Projects. Chris Hackett. Weldon Owen; 2018. ISBN-13: 978-1681884325.
6.	The Total Inventors Manual (Popular Science): Transform Your Idea into a Top-Selling Product. Sean Michael Ragan (Author). Weldon Owen; 2017. ISBN-13: 978-1681881584.
7.	Make: Tools: How They Work and How to Use Them. Platt, Charles. Shroff/Maker Media. 2018. ISBN-13: 978-9352137374
8.	The Art of Electronics. 3rd edition. Paul Horowitz and Winfield Hill. Cambridge University Press. ISBN: 9780521809269
9.	Practical Electronics for Inventors. 4th edition. Paul Sherz and Simon Monk. McGraw Hill. ISBN-13: 978-1259587542
10.	Encyclopedia of Electronic Components (Volume 1, 2 and 3). Charles Platt. Shroff Publishers. ISBN-13: 978-9352131945, 978-9352131952, 978-9352133703
11.	Building Scientific Apparatus. 4th edition. John H. Moore, Christopher C. Davis, Michael A. Coplan and Sandra C. Greer. Cambridge University Press. ISBN-13: 978-0521878586
12.	Programming Arduino: Getting Started with Sketches. 2nd edition. Simon Monk. McGraw Hill. ISBN-13: 978-1259641633

13.	Make Your Own PCBs with EAGLE: From Schematic Designs to Finished Boards. Simon Monk and Duncan Amos. McGraw Hill Education. ISBN-13 : 978-1260019193.
14.	Pro GIT. 2nd edition. Scott Chacon and Ben Straub. A press. ISBN-13 : 978-1484200773
15.	Venuvinod, PK., MA. W., Rapid Prototyping – Laser Based and Other Technologies, Kluwer, 2004.
16.	Ian Gibson, David W Rosen, Brent Stucker., "Additive Manufacturing Technologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010
17.	Chapman W.A.J, "Workshop Technology", Volume I, II, III, CBS Publishers and distributors, 5th Edition,2002.

Strength of CO-PO Mapping												
	PO											
	1	2	3	4	5	6	7	8	9	10	11	12
CO1	3	1	-	-	-	-	-	-	-	-	-	2
CO2	3	1	2	-	-	-	-	-	-	-	-	2
CO3	3	3	2	2	2	-	-	-	-	-	-	2
CO4	3	1	-	-	2	-	-	-	2	-	-	2
CO5	3	3	2	2	2	-	-	-	-	-	-	2

Guidelines for Tutorial / Term work Assessment		
Sr. No.	**Components for Tutorial / Term work Assessment**	**Marks Allotted**
1	Tutorial/Practical (Each carries 02 marks)	12
2	Timely completion Tutorial/ Practical	8
3	Attendance (Above 95 % : 05 Marks, below 75% : 0 Marks)	5
	Total	**25**

List of Tutorial /Practical Assignments		
Sr. No.	**Title**	**CO Mapped**
1	Measurement of dimension of any mechanical device or 3D scanner and create a production drawing including fits and tolerance.	CO1,
2	Study the different of welding joints and development of any joint by using welding machine	CO1, CO2
3	Development of mechanical linkage application with use of design software, manufacture it by using Laser cutter	CO3, CO1
4	Schematic and PCB layout design of a suitable circuit, fabrication PCB by using CNC machine, assemble the component and testing of the circuit	CO4, CO1
5	Familiarity and use of normal and wood lathe	CO3
6	Embedded programming using Arduino	CO4, CO1

Guidelines for Laboratory Conduction
36. Teacher will brief the given practical experiment to students its Design / Programme procedure, observations calculation, and outcome of this experiment. 37. Apparatus and equipments required for the allotted experiment will be provided by the lab

assistants using SOP.

38. Students will perform the allotted experiment in a group Three students in each group) under the supervision of faculty and lab assistant.
39. After performing the practical students will check their readings, product /Programme/calculations from the teacher.
40. After checking they have to write the conclusion of the final result.

Guidelines for Student's Lab Journal

Write-up should include title, aim, diagram, working principle, procedure, observations, and calculations, photograph of experiment, conclusion and questions, if any.

Guidelines for Term work Assessment

17. Each experiment from lab journal is assessed for thirty marks based on three rubrics.
18. Rubric R-1 for timely completion, R-2 for understanding and R-3 for presentation/journal writing where each rubric carries ten marks.