SYLLABUS
for
4th SEMESTER

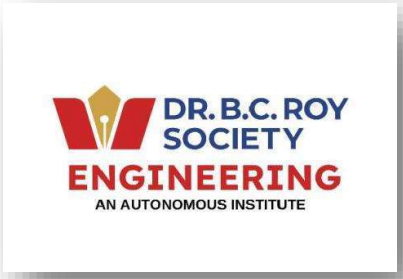
B.TECH. DEGREE

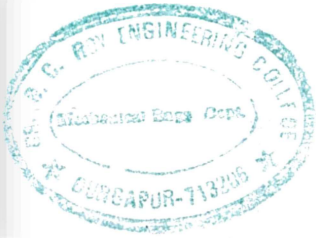
in

MECHANICAL ENGINEERING

(Applicable from the academic session 2024-2025)

Approved by BOS(ME) dt 5.11.2024 &
Academic Council, Agenda-01.02, dt 21.11.2024





Dr. B. C. Roy Engineering College

An Autonomous Institution

Approved by: All India Council for Technical Education (AICTE)

Affiliated to: Maulana Abul Kalam Azad University of Technology, West Bengal (Formerly Known as -WBUT)

Jemua Road, Durgapur, West Bengal, India,713206

Course Name: Mechanism
Course Code: ME-210
(Semester IV)
Course Broad Category: Professional courses

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1. **Course Prerequisite:**
   Mathematics, Mechanics.

2. **Course Learning Objectives:**
   The objective of this courses to familiarize the prospective engineers with techniques in calculus multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advance level that will serve them well towards tackling more advance level of mathematics and applications that they would find useful in their disciplines This course aims to familiarize the students with basic knowledge of mechanisms and linkages, their velocity analysis, Cams and followers and bearings. The students will be able to demonstrate skill in analyzing cams, gear profiles and gear trains.
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3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

   Evaluation System –

   CIA-1: 40 Marks
   (Class Test (Objective + Subjective): 25 Marks, Assignment: 10 Marks, Attendance: 5Marks)

   CIA-2: 40 Marks
   (Class Test (Objective + Subjective): 25 Marks, Assignment: 10 Marks, Attendance: 5 Marks)

   End-Semester Examination: 60 Marks

4. **Course Content:**
   Course Name: Mechanism
   Course Code: ME-210
   Hours per Week: 2L:1T:0P
   Credits: 3

Module	Topics	45L
1.	**Classification of mechanisms:** Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashofs law, Kinematic inversions of four bar chain and slider crank chains. Limit positions- Mechanical advantage- Transmission angle Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms.	9L

2.	**Velocity and Acceleration analysis:** Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous	10L

	centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics- Coincident points- Coriolis component of acceleration- introduction to linkage synthesis- three position graphical synthesis for motion and path generation.	
3.	**Classification of cams and followers:** Terminology and definitions- Displacement diagrams- Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions- specified contour cams- circular and tangent cams pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers.	8L
4.	**Gear Profiles:** Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics.	8L
5.	**Surface contacts:** sliding and rolling friction- friction drives bearings and lubrication, Friction clutches- Belt and Rope drives Friction in brakes.	10L

5. References:

Text Book:

- Ghosh Amitabha, Mallick A. K., Theory of Mechanisms and Machines, East West
- Norton R. L., Kinematics and Dynamics of Machinery, Mc Graw Hill Education.

Reference Books:

- Khurmi R. S., Gupta J. K., Theory of Machines, S Chand.
- Dukkipati R. V., Rao J.S., Mechanisms and Machine Theory, New Age International Publishers.
- Bevan, Thomas, The Theory of Machines, Pearson Education, 2010
- John J. Uicker, Jr., Gordon R. Pennock, Josepj E. Shigley, Theory of Machines and Mechanisms, 6th Edition, Cambridge University Press.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO 1	Analyze the motion of simple mechanisms in terms of the displacement, velocity and acceleration at any point on a rigid link. Also, determine the degree of freedom of simple mechanisms and their inversions.	Analyze	Analyze
CO 2	Synthesize higher pair mechanisms (cam & gear systems) to generate specified output motion.	Synthesize	Create
CO 3	Understand the relative motion of friction surfaces in contact and apply the knowledge during the design of the machine parts which work on the principle of rolling and sliding friction.	Apply	Apply
CO 4	Understand basic concepts of Gear profiles and gear trains kinematics	Understand	Understand
CO 5	Explore flywheels and their applications	Explore	Apply
CO 6	Apply mechanisms for different mechanical systems.	Apply	Apply

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	2	-	-	-	1
2	3	2	-	-	-	-
3	1	3	-	-	-	-
4	1	2	-	3	-	2
5	1	2	3	-	-	-

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1
CO1	3	1	1	1	-	-	-	-	-	-	-
CO2	3	1	1	1	-	-	-	-	-	-	-
CO3	3	1	1	1	-	-	-	-	-	-	-
CO4	3	1	1	1	-	-	-	-	-	-	-
CO5	3	1	1	1	-	-	-	-	-	-	-
CO6	3	1	1	1	-	-	-	-	-	-	-

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
CO1	1	3
CO2	1	3
CO3	1	3
CO4	1	3
CO5	1	3
CO6	1	3

***** End of Syllabus*****

Course Name: Applied Thermodynamics
Course Code: ME 211
(Semester IV)
Course Broad Category: Professional Core Courses

1. **Course Prerequisite:**
   Engineering Thermodynamics (ME 204) and Chemistry and Physics of Class 10+2.

2. **Course Learning Objectives:**
   To learn combustion processes using stoichiometry and thermodynamics, including adiabatic flame temperature and chemical equilibrium.
   To evaluate the performance of vapor and gas power cycles, including Rankine, Otto, Diesel, Brayton, and combined cycles.
   To learn about psychrometric principles to analyze air conditioning processes, including heating, cooling, humidification, and dehumidification.
   To learn about compressible flow phenomena, including isentropic flow, choked flow, normal shocks, and nozzle/diffuser efficiency.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

   Evaluation System –

CIA-1-40 MARKS (Class Test (Objective + Subjective)): 25Marks, Assignment: 10 Marks, Attendance: 5 Marks

CIA-2-40 MARKS (Class Test (Objective + Subjective)): 25Marks, Assignment: 10 Marks, Attendance: 5 Marks

END SEMESTER EXAMINATION: 60 MARKS

4. **Course Content:**
   Course Name: Applied Thermodynamics
   Course Code: ME 211
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	45L
1.	Introduction to solid, liquid and gaseous fuels– Stoichiometry, exhaust gas analysis- First law analysis of combustion reactions- Heat calculations using enthalpy tables- Adiabatic flame temperature- Chemical equilibrium, free energy.	10L
2.	Vapor power cycles: Rankine cycle with superheat, reheat and regeneration, exergy analysis. Super-critical and ultra- super-critical Rankine cycle- Gas power cycles, Air standard Otto, Diesel and Dual cycles- Air standard Brayton cycle, effect of reheat, regeneration and intercooling- Combined gas and vapor power cycles- Vapor compression and vapour	18L

	absorption refrigeration cycles, refrigerants and their properties.	
	Properties of dry and wet air, use of psychometric chart, processes involving heating/cooling and humidification/dehumidification, dew point.	
3.	Basics of compressible flow. Stagnation properties, Isentropic flow of a perfect gas through a nozzle, choked flow, subsonic and supersonic flows-normal shocks- use of ideal gas tables for isentropic flow and normal shock flow- Flow of steam through nozzle, super saturation-compressible flow in diffusers, efficiency of nozzle and diffuser.	13L
	Reciprocating compressors, staging of reciprocating compressors, optimal stage pressure ratio, effect of intercooling, minimum work for multistage reciprocating compressors.	
4.	Analysis of steam turbines, velocity and pressure compounding of steam turbines	4L

5. References:

1. Sonntag, R. E, Borgnakke, C. and Van Wylen, G. J., 2003, 6th Edition, *Fundamentals of Thermodynamics*, John Wiley and Sons.
2. Jones, J. B. and Duggan, R. E., 1996, *Engineering Thermodynamics*, Prentice-Hall of India
3. Moran, M. J. and Shapiro, H. N., 1999, *Fundamentals of Engineering Thermodynamics*, John Wiley and Sons.
4. Nag, P.K, 1995, *Engineering Thermodynamics*, Tata McGraw-Hill Publishing Co. Ltd.
5. M.P. Poonia & S.C. Sharma, Basics of Mechanical Engineering, Khanna Publishing House, N.Delhi.
6. Cengel, Y., Boles, M., Kanoğlu, M., 2019, 9th Edition, Thermodynamics: An Engineering Approach, McGraw Hill.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ME 211.1	**ANALYSE** reacting systems using mass, energy and entropy balance and to determinechemical equilibrium composition.	Analyse	Analyse
ME 211.2	**ILLUSTRATE** vapour power cycles, gas power cycles and refrigeration cycles.	Illustrate	Analyse
ME 211.3	**USE** psychrometric processes in real world air-conditioning systems.	Use	Apply
ME 211.4	**EXPLORE** the compressible fluid flow through nozzles, diffusers etc.	Explore	Apply
ME 211.5	**UNDERSTAND** the operation of reciprocating compressors and to determine itsperformances.	Understand	Understand
ME 211.6	**ANALYSE** steam turbines thermodynamically	Analyse	Analyse

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	2	1	-	-	-
3	-	-	-	2	1	-
4	-	-	-	-	-	3

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ME 211.1	2	3	2	1	1	-	1	1	-	1	1
ME 211.2	2	3	2	1	1	-	1	1	-	1	1
ME 211.3	2	3	2	1	1	-	1	1	-	1	1
ME 211.4	2	3	2	1	1	-	1	1	-	1	1
ME 211.5	2	3	2	1	1	-	1	1	-	1	1
ME 211.6	2	3	2	1	1	-	1	1	-	1	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
ME 211.1	3	2
ME 211.2	3	2
ME 211.3	3	2
ME 211.4	3	2
ME 211.5	3	2
ME 211.6	3	2

***** End of Syllabus*****

Course Name: Machining Principles & Machine Tools
Course Code: ME-212
(Semester IV)
Course Broad Category: Professional core course

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1. **Course Prerequisite:**
   Manufacturing Processes

2. **Course Learning Objectives:**
   The objective of this course is to familiarize prospective engineers with the fundamental principles of machining processes and machine tools. It aims to equip students with essential concepts, analytical techniques, and practical knowledge required to understand chip formation mechanisms, cutting forces, tool wear, and machining efficiency. The course provides a comprehensive understanding of machine tool operations, automation, and kinematic structures to enhance students' ability to optimize machining performance and apply economic considerations in manufacturing processes.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

   Evaluation System –
   CIA-1-40 MARKS (Class Test (Objective + Subjective): 25 Marks, Assignment: 10 Marks, Attendance: 5 Marks
   CIA-2-40 MARKS (Class Test (Objective + Subjective): 25 Marks, Assignment: 10 Marks, Attendance: 5 Marks
   END SEMESTER EXAMINATION: 60 MARKS

4. **Course Content:**
   Course Name: Machining Principles & Machine Tools
   Course Code: ME-212
   Hours per Week: 2L: 1T: 0P
   Credits: 3

Module	Syllabus/Lecture Schedule	40L
1	**Introduction:** Machining: Basic principle, purpose, definition and requirements	1
	Geometry of cutting tools: 1. Geometry of single point turning (shaping, planning and boring) tools in ASA, ORS and NRS systems 2. Conversion of tool angles from one system to another by graphical and vector methods 3. Geometry of drills and milling cutters	4

	Mechanism of machining: 1. Chip formation mechanism, yielding and brittle fracture, chip reduction coefficient, cutting ratio, shear angle and cutting strain 2. Built-up edge formation, cause, type and effects, orthogonal cutting and oblique cutting 3. Machining chips: types and conditions, chip formation in drilling and milling	4
2	**Mechanics of machining:** 1. Purposes of determination of cutting forces and basic two approaches, cutting force components in ORS and Merchant's circle diagram 2. Determination of cutting forces, analytical methods, measurement 3. Dynamometers, construction and working principles of strain gauge type and piezoelectric crystals type turning drilling, milling and grinding dynamometers	4
	Cutting temperature: 1. Heat generators and cutting zone temperature, sources, courses and effects on job and cutting tools, role of variation of the machining parameters on cutting temperature 2. Determination of cutting temperature by analytical and experimental methods 3. Control of cutting temperature and application of cutting fluids (purpose, essential properties, selection and methods of application)	3
	Cutting tools-failure, life and materials: 1. Methods of failure of cutting tools mechanisms, geometry and assessment of tool wear 2. Tool life, definition, assessment and measurement, Taylor's tool life equation and it's use 3. Cutting tool materials, essential properties, characteristics and applications of HSS, carbide (uncoated/coated), ceramic, diamond and CBN tools	4
3	**Machine tools – Introduction:** 1. Purpose of use, definition and general features of machine tools 2. Generatrix and Directrix and tool – work motions in different operations of conventional machine tools	2
	General constructions function of machine tools: 1. Major components and their functions in lathes; shaping, planning and slotting machines; drilling machines and melting machines 2. Machining operations and application of the common machine tools and their way of specification	4
	Broaching and grinding: 1. Modes and mechanisms of chip formation, selection and application 2. Grinding forces, surface roughness and wheel life	2

	Automation and classification: 1. Purposes, degree, type and economy of machine tool automation; broad classification of machine tools	1
4	**Kinematic structure of machine tools :** 1. Kinematic structure of centre lathe, shaping, planning and slotting machine 2. Kinematic structure of drilling (column /radial) and milling machines, capstan lathe, turret lathes 3. Kinematic structure of single spindle automatic lathe, by hydraulically driven machine tools, hobbling machine and gear shaping machine	3
	Control of speed and feed machine tools: 1. Need of wide ranges of speeds and feeds, and machine tool drive 2. Design of speed, gear box, speed layout, gear layout, ray diagrams, gears and spindle 3. Control (selection and change) of feed in centre lathes and by hydraulically driven machine tools	4
	Machining time: 1. Estimation of time required for various operations like turning, drilling , shaping , milling and gear teeth generation	2
	Machinability and machining economics: 1. Machinability (and grindability), definition, assessment, improvement and evaluation of optimum cutting velocity and tool life	2

5. References:

TEXT BOOK(S):

1. A.B. Chattopadhyay, Machining and Machine Tools, Wiley India (P) Ltd., New Delhi.
2. P.N. Rao, Manufacturing Technology Vol. 2, McGraw Hill, 2018.

REFERENCE(S):

1. G. Kuppuswamy, Principles of Metal Cutting, University Press, Hyderabad.
2. Stephenson & Agapion, Metal Cutting Theory and Practice, Taylor and Francis, NY.
3. M.C. Shaw, Metal Cutting Principles and Practices, Oxford University Press.
4. G.C. Sen and A. Bhattacharyya, Principles of Machine Tools, New Central Book Agency (P) Ltd., Kolkata.
5. Acharkan, Machine Tool Design, Vol. I, II, III and IV, Mir Publication, Moscow.
6.
7. Y. Koren, Computer Control of Manufacturing Systems, McGraw Hill, 1986.
8. M.P. Grover, Fundamentals of Modern Manufacturing, 3rd Edition, Wiley.
9. M.P. Groover, Automation, Production Systems and CIM, Prentice Hall.
10. A. Ghosh & A.K. Mullick, Manufacturing Science, EW Press.
11. S. Kalpakjian and S.R. Schmid, Manufacturing Processes for Engineering Materials, 5th Edition, Pearson India, 2014.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ME-212.1	**Examine** chip formation mechanisms	**Examine**	Analyze

	and the impact of orthogonal and oblique cutting.		
ME-212.2	**Assess** cutting forces, temperatures, tool failure, and tool life through analytical methods.	**Assess**	Evaluate
ME-212.3	**Explain** the construction, operation, and applications of various machine tools.	**Explain**	Understand
ME-212.4	**Investigate** factors influencing cutting tool wear and evaluate different cutting tool materials.	**Investigate**	Apply
ME-212.5	**Utilize** speed layout, gear design, and machining time estimation to optimize operations.	**Utilize**	Analyze
ME-212.6	**Implement** machinability and machining economics principles to enhance machining efficiency.	**Implement**	Apply

6. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	-	-	-
2	-	3	-	2	-	-
3	-	-	3	-	-	-
4	-	-	-	-	3	2

7. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	3	1	-	-	-	1	-	2	-	1
CO2	1	3	1	-	-	-	1	-	2	-	1
CO3	1	3	1	-	-	-	1	-	-	-	1
CO4	1	3	1	-	-	-	1	-	-	-	1
CO5	1	3	1	-	-	-	1	-	-	-	1
CO6	1	2	3	-	-	-	1	-	-	-	1

8. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2
CO6	3	2

***** End of Syllabus*****

Course Name: Metrology & Instrumentation
Course Code: ME 213
(Semester IV)
Course Broad Category: Professional Core

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1. **Course Prerequisite: Nil**

2. **Course Learning Objectives:**
   The course objective of "Metrology and Instrumentation" is to provide students with a comprehensive understanding of measurement principles, techniques, and instruments used to accurately measure various physical parameters like length, angle, surface finish, and more, enabling them to select and utilize appropriate instruments for quality control and precision manufacturing processes within engineering applications; essentially, teaching students how to precisely measure and inspect components using specialized tools and techniques.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

   Evaluation System–

CIA-1-40 MARKS (Class Test (Objective + Subjective):25Marks, Assignment: 10Marks, Attendance: 5 Marks

CIA-2-40 MARKS (Class Test (Objective + Subjective):25Marks, Assignment: 10Marks, Attendance: 5 Marks

ENDSEMESTEREXAMINATION: 60 MARKS

4. **Course Content:**
   Course Name: Metrology & Instrumentation
   Course Code: ME 213
   Hours per Week: 3L: 0T: 0P
   Credits: 3

Module	Topics	40L
1.	Concept of measurement:-Introduction to Metrology; Need for high precision measurements; Terminologies in Measurement- Precision, accuracy, sensitivity, calibration, resolution. Errors in Measurement, types of errors, Abbe's Principle. Basic standards of length- Line standard, End standards, Wavelength standard; VariousShopfloorstandards.LinearMeasurement–Slipgauges,wringing,grades; Surface plate; Dial indicators; Height gauges and Vernier calliper; screw gauge. Comparators-mechanical, electrical, optical and pneumatic. Angular Measurement – Bevel protractor; Sine Bar, principle and use of sine bar, sine centre; Angle gauges. Sprit level; Angle Dekkor; Clinometers.	8L
2.	Limits and Limit gauges –Making to suit, selective assembly, systems of limits and fits; Types of fits; Hole basis system and Shaft basis system. Tolerance,	8L

	Allowance and deviation (as per BIS). Limit Gauges –GO and NOGO gauges; types of limit gauges. Gauge design - Taylor's principle of gauging; Gauge tolerance, disposition of gauge tolerance, wear allowance. Optical Measuring Instruments: - Benefits of light waves as standards; Monochromatic light; Principle of Interference. Interference band, optical flat, surface measurement. Interferometers – NPL, Pitter-NPL, auto collimator.	
3.	Screw thread measurement – Screw thread terminology; Measurement of major diameter; root diameter; pitch; effective diameter with two wire method and three wire method. Measurement of flank angle and form by profile projector and microscope. Measurement of surface texture – roughness and waviness; Analysis of surface traces, peak to valley height, R.M.S. value, Centre Line Average and Ra value, Rt, Rz etc. Methods of measuring surface roughness – Stylus probe, Tomlinson surface meter, Talysurf; surface roughness measurement – assessment length, roughness width cut-off, sampling length and evaluation length.	8L
4.	Introduction to Digital Measurement– significance of Digital measurement; methods; Classification. Stages in generalized measuring system– Sensor- Transducer stage, Signal-Conditioning stage, Readout-Recording stage; Types of input quantities; Active and Passive transducers. Performance characteristic of measuring devices. Drift, Resolution, Threshold, Hysteresis, Static calibration. Dynamic characteristics-different order systems and their response-, Measuring lag, Fidelity, Dynamic error; Transducers– Working, Classification of transducers. Motion and Dimension measurement – LVDT – Principle, applications, advantages and limitations. Strain and Stress Measurement- Electrical resistance strain gauge- Principle, operation. Measurement of Force and Torque– Strain-Gauge Load Cells, Hydraulic and Pneumatic load cells– force measurement using piezoelectric quartz crystal. Torque Measurement– Dynamometers– Mechanical, Hydraulic and Electrical. Vibration measurement– Vibrometers and Accelerometers. Temperature Measurement– Use of Thermal Expansion– Liquid-in-glass thermometers, Bimetallic strip thermometer, Pressure thermometers. Thermocouples– Resistance Temperature Detectors (RTD); Thermistors; Pyrometers.	16L

5. Learning Resources:

1. Anand KBewoor,Vinay A Kulkarni,Metrology & Measurement,McGraw-Hill,2009
2. Ernest O. Doebelin, Dhanesh N. Manik,Measurement Systems Application and Design, McGraw-Hill, 2004
3. GalyerJ.F.W.,SchotboltC.R.,MetrologyforEngineers,ELBS,1990
4. Thomas G. Beckwith, John H. L., Roy D. M., Mechanical Measurements, 6/E, Pearson Prentice Hall, 2007
5. R. K. Rajput, Mechanical Measurements &Instrumentation, S. K. Kataria &Sons.

6. CourseOutcomes(CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ME 213.1	**REMEMBER** the different surface roughness measurement techniques and Related devices.	Remember	Remember

ME 213.2	**APPLY** the knowledge of the standards of Lengths and angle measurements for measuring machine elements.	Apply	Apply
ME 213.3	**ANALYSE and APPLY** the knowledge of optical measurements.	Analyseand Apply	Analyse and Apply
ME 213.4	**UNDERSTAND** the various transducers to measure displacements.	Understand	Understand
ME 213.5	**ANALYSE** various temperature and pressure transducers for different engineering applications.	Analyse	Analyse
ME 213.6	**UNDERSTAND** the shaft and hole tolerances and fits for selected assembly.	Understand	Understand

7. Mapping of course outcomes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	2	-	1
2	2	3	-	1	-	1
3	2	3	3	2	-	1
4	3	-	-	2	-	1
5	2	-	-	1	3	1

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1	2	-	-	-	-	-	1
CO2	1	2	3	1	-	-	-	-	-	-	1
CO3	1	2	2	1	1	-	-	-	-	-	1
CO4	1	2	1	1	2	-	-	-	-	-	2
CO5	2	2	2	2	3	-	-	-	-	-	1
CO6	1	1	1	1	-	-	-	-	-	-	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1

CO6		

*****Endof Syllabus*****

Course Name: Design of Machine Elements
Course Code: ME-214
(Semester 4)
Course Broad Category: Mechanical Engineering

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1. Course Prerequisite: Concept of Engineering Mechanics & Strength of Materials

2. Course Learning Objectives:
The objective of this courses to familiarize the prospective engineers with techniques in calculus multivariate analysis and linear algebra. It aims to equip the students with standard concepts and tools at an intermediate to advance level that will serve them well towards tackling more advance level of mathematics and applications that they would find useful in their disciplines.

3. Teaching methodology and evaluation system for the course:
Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System –

CIA-1: 40 Marks
(Class Test (Objective + Subjective): 25 Marks, Assignment: 10 Marks, Attendance: 5Marks)

CIA-2: 40 Marks
(Class Test (Objective + Subjective): 25 Marks, Assignment: 10 Marks, Attendance: 5 Marks)

End-Semester Examination: 60 Marks

4. Course Content:
Course Name: Design of Machine Elements
Course Code: ME-214
Hours per Week: 3L: 0T: 0P
Credits: 3

Syllabus:

Module No.	Description of Topic	Contact Hrs.
1	**Introduction to Machine Design** Design philosophy, Selection of Engineering Materials, Manufacturing considerations in Design, Mechanical Properties of Materials, Standardization, Traditional Design Methods, Design Synthesis, Aesthetic Considerations in Design, and Ergonomic Considerations in Design.	3
2	**Design for Strength** Design against static loading: Theories of Failures: Maximum Principal Stress, Maximum-Shear Stress, Distortion energy theory, Selection and Use of theories of failures; Factor of safety, Contact stresses, Crushing and Bearing stress. Design against dynamic loading: SN diagram, Low cycle fatigue and high cycle fatigue, Endurance limit, Cumulative Damage in Fatigue, Soderberg and Goodman Lines, Fatigue strength formulations, Stress concentration.	6
3	**Design of Fasteners** Types of fasteners- Permanent fasteners and detachable fasteners, Design of Permanent fasteners: Design of Riveted joints, Design of Welded joints; Design of Detachable Fasteners: Design of Cotter joints, Design of Knuckle joints, Design of Bolted joints.	10
4	**Shafts and Keys**	5

	Design of solid and hollow circular shaft subjected to torque, bending moment and combined loading for rigidity and stiffness; Design of Keys- Design of Sunk Keys;	
5	**Belt Drives and Gears** Belt Drives: Types, Belt Constructions, Geometrical Relationships, Analysis of Belt Tensions, and Condition for Maximum Power Design, Design of Flat Belt drives. Gears: Introduction to Gears, Types of Gears and their Applications, Selection of Gears, Terminology of Spur Gears, Force Analysis, Spur Gear Design, Gear Tooth Failures.	3
6	**Brakes and Clutches** Drum Brakes, Pivoted Shoe Brakes, Energy Consideration in Brakes, Plated Clutches, Energy Consideration in Clutches.	5

Learning Resources:

1. Design of Machine Elements, V B Bhandari, McGraw Hill.
2. Mechanical Engineering Design- Shigley, McGraw Hill.
3. Machine Design: An Integrated Approach, R L Norton, Pearson

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO1	**Visualize** the principles of design philosophy and material selection, incorporating manufacturing considerations and standardization in engineering design.	**VISUALIZE**	**Understand**
CO2	**Demonstrate** theories of failure and concepts of static and dynamic loading to design components with appropriate factors of safety and endurance limits.	**DEMONSTRATE**	**Apply**
CO3	**Classify** the design requirements and create appropriate solutions for both permanent and detachable fasteners, including riveted, welded, cotter, knuckle, and bolted joints.	**CLASSIFY**	**Analyze**
CO4	**Determine** the stresses and deflections in solid and hollow shafts under various loading conditions, and design keys for effective power transmission.	**DETERMINE**	**Evaluate**
CO5	**Allocate** the design principle in designing flat belt drive systems.	**ALLOCATE**	**Apply**
CO6	**Calculate** various design parameters to design efficient braking and clutch systems..	**CALCULATE**	**Apply**

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	**3**	**-**	**-**	**2**	**-**	**1**
2	**2**	**3**	**-**	**1**	**-**	**1**
3	**2**	**3**	**3**	**2**	**-**	**1**
4	**3**	**-**	**-**	**2**	**-**	**1**
5	**2**	**-**	**-**	**1**	**3**	**1**
6	**-**	**-**	**-**	**-**	**-**	**-**

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	1	2	1	-	-	1	1	1	-	1
CO2	1	1	2	1	-	-	1	1	1	-	1
CO3	2	1	3	1	-	-	1	1	1	-	1
CO4	2	2	3	1	-	-	1	1	1	-	1
CO5	1	2	3	1	-	-	1	1	1	-	1
CO6	1	2	3	1	-	-	1	1	1	-	1
Average	1.33	1.50	2.67	1	-	-	1.0	1.0	1.0	-	1.0

9. Mapping to Program Specific Outcome (PSO)

	PSO 1	PSO 2
CO1	3	1
CO2	3	1
CO3	3	1
CO4	3	1
CO5	3	1
CO6	3	1

*****End of Syllabus*****

Course Name: Essence of Indian Knowledge
Course Code: ME-215
(Semester IV)
Course Broad Category: VALUE ADDED

1. **Course Prerequisite:**
   Some familiarity with India's historical and philosophical traditions.

2. **Course Learning Objectives:**
   To facilitate the students with the concepts of Indian traditional knowledge and to make them understand the Importance of roots of knowledge system.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

4. **Course Content:**
   Course Name: Essence of Indian Knowledge
   Course Code: ME-215
   Hours per Week: 1L: 0T: 0P
   Credits: 0

Module	Topics	45L
1.	**Unit1: Introduction to traditional knowledge :** Define traditional knowledge, nature and characteristics, scope and importance, kinds of traditional knowledge, the physical and social contexts in which traditional knowledge develop, the historical impact of social change on traditional knowledge systems. Indigenous Knowledge (IK), characteristics, traditional knowledge vis-à-vis indigenous knowledge, traditional knowledge Vs western knowledge traditional knowledge vis-à-vis formal knowledge	9L
2.	**Unit-II: Protection of traditional knowledge:** The need for protecting traditional knowledge Significance of TK Protection, the value of TK in the global economy, Role of Government to harness TK.	9L
3.	**Unit-III: Legal framework and Traditional Knowledge:** A: The Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006, Plant Varieties Protection and Farmers Rights Act, 2001 (PPVFR Act); B: The Biological Diversity Act 2002 and Rules 2004, the protection of traditional knowledge bill, 2016. Geographical indications act 2003 .	9L
4.	**Unit-IV: Traditional knowledge and intellectual property:** Systems of traditional knowledge protection, Legal concepts for the protection of traditional knowledge, Certain non IPR mechanisms of traditional knowledge protection, Patents and traditional knowledge, Strategies to increase protection of traditional knowledge, global legal FORA for increasing protection of Indian Traditional	9L

	Knowledge	
5.	**Unit-V: Traditional knowledge in different sectors :** Traditional knowledge and engineering, Traditional medicine system, TK and biotechnology, TK in agriculture, Traditional societies depend on it for their food and healthcare needs, Importance of conservation and sustainable development of environment, Management of biodiversity, Food security of the country and protection of TK.	9L

5. References:

Text Book:

1. Traditional Knowledge System in India, by Amit Jha, 2009.
2. Traditional Knowledge System and Technology in India by Basanta Kumar Mohanta and Vipin Kumar Singh, Pratibha Prakashan 2012

Reference Books:

1. Traditional Knowledge System in India by Amit Jha Atlantic publishers, 2002
2. "Knowledge Traditions and Practices of India" Kapil Kapoor, Michel Danino

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
CO 1	**Understand** the concept of Traditional knowledge and its importance	**Understand**	Remember
CO 2	**Know** the need and importance of protecting traditional knowledge	**Know**	Remember
CO 3	**Know** the various enactments related to the protection of traditional knowledge	**Know**	Remember
CO 4	**Understand** the concepts of Intellectual property to protect the traditional knowledge	**Understand**	Understand
CO 5	**Understand** the traditional knowledge in different sectors	**Understand**	Remember

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	2	3	3	-	-	-
2	-	-	-	3	2	-
3	-	-	-	2	3	-
4	-	-	-	-	-	3
5	-	-	3	2	-	-

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2
CO1	1	1	-	1	-	1	1	2	1	1	-	1
CO2	1	1	-	1	-	1	1	2	1	1	-	1
CO3	1	1	-	1	-	1	1	2	1	1	-	1
CO4	2	2	3	1	3	1	1	1	1	1	-	1
CO5	2	2	3	1	1	1	-	1	1	1	-	2
CO6	2	2	3	1	1	1	1	1	1	1	-	2

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
CO1	2	2
CO2	2	2
CO3	2	2
CO4	2	2
CO5	2	2
CO6	2	2

***** End of Syllabus*****

Course Name: Machine Tools Lab
Course Code: ME-216
(Semester IV)
Course Broad Category: Professional core course

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1. **Course Prerequisite:**
   Manufacturing Processes

2. **Course Learning Objectives:**
   The objective of this course is to provide hands-on experience with various machining operations and measurement techniques. It aims to equip students with practical knowledge of turning, milling, shaping, drilling, and grinding processes. The course focuses on evaluating cutting forces, tool wear, chip formation, and surface roughness. Students will develop skills in machining different materials, understanding tool life, and optimizing machining parameters for improved efficiency and quality in manufacturing.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Conduction laboratory experiments, Correlate with Theory by Interactive Discussions and Case Studies.

   Evaluation System –

A. Summative Assessment (PCIA)-(60 Marks)
B. Practical End-Semester Exam(PESE)- (40 Marks)

4. **Course Content:**
   Course Name: Machine Tools Lab
   Course Code: ME-216
   Hours per Week: 0L: 0T: 4P
   Credits: 2

   At least 6 (six) of the following experiments/ assignments to be conducted:

S. No.	Lab Description	Hours (days)
1	To perform the step turning, taper turning, knurling and threading operation on a given M.S. work piece.	3(1)
2	Measurement of cutting forces (Pz and Px or Py) in straight turning at different feeds and velocities.	3(1)
3	Measurement of average cutting temperature in turning under different speed – feed combinations.	3(1)
4	Measurement of surface roughness in turning under different conditions.	3(1)
5	Study of chip formation (type, color & thickness) in turning mild steel and evaluation of role of variation of cutting velocity and feed on chip reduction coefficient /cutting ratio and shear angle.	3(1)
6	Measurement of tool – wear and evaluation of tool life in turning mild steel by HSS or carbide tool.	3(1)
7	Producing a cast iron vee – block by machining.	6(2)

8	Production of a straight toothed spur gear from a cast or forged disc.	**6(2)**
9	To form and grind the given work piece (square rod) into single point cutting tool.	**3(1)**
10	To perform drilling, and tapping operations on the given M.S Flat work piece.	**3(1)**

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ME-216.1	**Measure** average cutting temperature & surface roughness in turning under different speed – feed combinations.	**Measure**	Analyze
ME-216.2	**Study** the chip formation (type, color &thickness) through experiment in turning mild steel and evaluation of role of variation of cutting velocity and feed on chip reduction coefficient /cutting ratio and shear angle.	**Study**	Analyze
ME-216.3	**Perform** measurement of cutting forces using a lathe dynamometer under different machining parameters relating potential effects of tool wear.	**Perform**	Apply
ME-216.4	**Prepare** jobs using various operations on Lathe & drilling machines.	**Prepare**	Apply
ME-216.5	**Produce** a cast iron 'V' block & a straight toothed spur gear from a cast or forged disc on shaper & milling machines.	**Produce**	Apply
ME-216.6	**Form** and grind the given work piece (square rod) into single point cutting tool.	**Form**	Apply

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	-	-	-	3	-	-
2	-	-	3	-	-	-
3	3	-	-	2	-	-
4	3	-	-	2	-	-
5	-	3	-	-	-	-
6	-	-	3	-	-	-
7	-	-	-	-	3	-
8	-	-	-	-	3	-
9	-	-	-	-	-	3
10	-	-	-	3	-	-

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	1	2	3	-	-	-	1	1	1	-	1
CO2	1	2	3	-	-	-	1	1	1	-	1
CO3	1	2	3	-	-	-	1	1	1	-	1
CO4	1	1	3	-	-	-	1	1	1	-	1
CO5	1	1	3	-	-	-	1	1	1	-	1
CO6	1	1	3	-	-	-	1	1	1	-	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	2
CO4	3	2
CO5	3	2
CO6	3	2

***** End of Syllabus*****

Course Name: Metrology & Instrumentation Lab.
Course Code: ME 217
(Semester IV)
Course Broad Category: Professional Core

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1. **Course Prerequisite: Nil**

2. **Course Learning Objectives:**
   The course objective of a "Metrology and Instrumentation Laboratory" is to provide students with practical experience in using various measuring instruments to accurately assess linear, geometric, angular, and surface finish dimensions of objects, while also teaching them proper calibration techniques and the principles of metrology to ensure reliable measurement results in engineering applications.

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Conduction laboratory experiments, Correlate with Theory by Interactive Discussions and Case Studies.
   Evaluation System–

A. Internal Assessment (60Marks)-Formative Continuous Assessment
B. End-Semester Exam (40Marks)-Summative Assessment.

4. **Course Content:**
   Course Name: Metrology & Instrumentation Lab
   Course Code: ME-217
   Hours per Week: 0L: 0T: 2P
   Credits: 1

Sl.No.	Lab. Descriptions	Contact Hours
1.	To determine the diameter of a cylindrical machined job with the help of a micrometer.	4Hr
2.	Measurement of length and diameter of cylindrical machined job and breadth &diameter of a cube work with a through hole in it by a Vernier Caliper.	4Hr
3.	Determination of angle, radius and gap thickness using of given	4Hr

	Specimen by using different Gauges.	
4.	Measurement of internal diameter of a parallel bore byusing steel halls and Vernier Height Gauge.	4hr
5.	Measurement of effective diameter of a screw thread byusing Screw Thread Micrometer.	4Hr
6.	To measure the angle of external taper by using Sine Bar and Slip Gauge.	4Hr
7.	Set up a length of a 20.039 mm by using slip gauges and check it by using Dial Micrometer.	4Hr
8.	Find out the back rack angle, side clearance angle of a right hand single point cutting tool by using profile projector.	4Hr

5. Learning Resources:

1. Lab. Manual

6. CourseOutcomes(CO):

Course Outcomes	**Details/Statement**	**Action Verb**	**Knowledge Level**
CO1	To **Understand** measurement errors and necessity of Calibration of Vernier, and Micrometer.	Understand	Understand
CO2	To **Apply** the knowledge of angular Measurement by using Sine Bar and Slip Gauges.	Apply	Apply
CO3	To **Analyse** the measurements using Optical Projector.	Analyse	Analyse
CO 4	To **Apply** the knowledge of measurement to determine the internal diameter by using spherical balls and height gauge.	Apply	Apply
CO 5	To **Analyse** Screw thread parameters	Analyse	Analyse

	Using screw thread micrometer.		
CO 6	To **Remember** the various sources of measurement errors like Sine-Error Cosine Errors and its necessary methods to minimise errors.	Remember	Remember

7. Mapping of course out comes to module/course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	3	-	-	2	-	1
2	2	3	-	1	-	1
3	2	3	3	2	-	1
4	3	-	-	2	-	1
5	2	-	-	1	3	1

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
CO1	2	2	1	1	2	-	-	-	-	-	1
CO2	1	2	3	1	-	-	-	-	-	-	1
CO3	1	2	2	1	1	-	-	-	-	-	1
CO4	1	2	1	1	2	-	-	-	-	-	2
CO5	2	2	2	2	3	-	-	-	-	-	1
CO6	1	1	1	1	-	-	-	-	-	-	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
CO1	2	1
CO2	2	1
CO3	2	1
CO4	2	1
CO5	2	1
CO6	2	1

***** End of Syllabus*****

Course Name: Corporate Communication & Soft Skill
Course Code: ME 218
(Semester IV)
Course Broad Category: Humanities and Social Sciences

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1. **Pre-requisite:** Basic English

2.Teaching methodology and evaluation system for the course:

Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

Evaluation System–

A. Internal Assessment (60 Marks) - Formative Continuous Assessment [Continuous Assessment]
B. End-Semester Exam (40 Marks) - Summative Assessment.

2. Course Content:

Course Name: Corporate Communication &Soft Skill
Course Code: ME 218
Hours per Week: 0L: 0T: 2P **Credits:** 1

Course Contents:

Module No.	Description of Topic	Contact Hrs.
1	Information Design and Development- Different kinds of technical documents, Information development life cycle, Organization structures, factors affecting information and document design, Strategies for organization, Information design and writing for print and for online media.	7
2	Technical Writing, Grammar and Editing- Technical writing process, forms of discourse, Writing drafts and revising, Collaborative writing, creating indexes, technical writing style and language. Basics of grammar, study of advanced grammar, editing strategies to achieve appropriate technical style. Introduction to advanced technical communication, Usability, Hunan factors, Managing technical communication projects, time estimation, Single sourcing, Localization.	8
3	Self Development and Assessment- Self assessment, Awareness, Perception and Attitudes, Values and belief, Personal goal setting, career planning, Self-esteem. Managing Time; Personal memory, Rapid reading, Taking notes; Complex problem solving; Creativity	6
4	Communication and Technical Writing- Public speaking, Group discussion, Oral; presentation, Interviews, Graphic presentation, Presentation aids, Personality Development. Writing reports, project proposals, brochures, newsletters, technical articles, manuals, official notes, business letters, memos, progress reports, minutes of meetings, event report.	8
5	Ethics- Business ethics, Etiquettes in social and office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics, Managing time, Role and responsibility of engineer, Work culture in jobs, Personal memory, Rapid reading, Taking notes, Complex problem solving, Creativity.	7

Learning Resources:

1. D. F. Beer and D. Mc Murrey, Guide to Writing as an Engineer, John Willey, New York,
2. D. Hacker, Pocket Style Manual, Bed ford Publication, New York, 2003.
3. S. Khera,You Can Win, Macmillan Books, New York, 2003.
4. R. Sharma, Technical Communications, Oxford Publication, London, 2004.
5. D. Jungk, Applied Writing for Technicians, McGraw Hill, New York, 2004.
6. R. Sharma and K. Mohan, Business Correspondence and Report Writing, 5th Edition, McGraw Hill Education, 2017.
7. Xebec, Presentation Book, McGraw Hill Education India, New Delhi, 2000.

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

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ME 218.1	Understand the dynamics of Verbal and Non-verbal aspects of technical communication	Identify	Understand
ME 218.2	Practice multi-step writing process to plan, draft, and revise reports, correspondence, and presentations.	Explain	Understand
ME 218.3	Illustrate and examine the knowledge of ethical aspects of engineering	Implement	Apply
ME 218.4	Demonstrate and explain social and professional etiquettes	Organize	Apply
ME 218.5	Plan self-development and practice self-assessment to function on multi-disciplinary teams.	Assess	Apply

Mapping of the Course out comes to Program Outcomes:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11
ME 218.1	3	2	1	1	1	-	-	-	-	-	1
ME 218.2	3	2	1	1	1	-	-	-	-	-	1
ME 218.3	2	2	1	1	1	-	-	-	-	-	1
ME 218.4	2	2	1	1	1	-	-	-	-	-	2
ME 218.5	2	2	1	1	1	-	-	-	-	-	1

Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
ME 218.1	1	2
ME 218.2	1	2
ME 218.3	1	2
ME 218.4	1	2
ME 218.5	1	2

***** End of Syllabus*****

Course Name: Python in Mechanical Engineering Laboratory
Course Code: ME-219
(Semester III)
Course Broad Category: Open Elective

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1. **Course Prerequisite:**

   Basic reasoning skills and basic concepts of Mechanical Engineering

2. **Course Learning Objectives:**

   - Understand the basics of Python Programming
   - Apply python programming techniques to mechanical engineering problems
   - Analyze and interpret data from mechanical systems

3. **Teaching methodology and evaluation system for the course:**
   Teaching methodology – Lectures and Presentations, Interactive Discussions and Case Studies, Guest Lectures.

   Evaluation System –

A. Mid-Term Exam (60 Marks)- Summative Assessment (PCIA)
B. Practical End-Semester Examination (40 Marks) – Summative Assessment

4. **Course Content:**

Course Name: Python in Mechanical Engineering Laboratory
Course Code: ME-219
Hours per Week: 0L: 1T: 3P
Credits: 1

Module	Topics	48H
1.	I Basic Features, Installation of Anaconda with Spyder, Jupiter Notebook etc. User Interface, Execution of Comments, Concept of Tuple,List (Array), Dictionary, Execution of Loops and conditionals,	28H
2.	Concept of a Function, Object Oriented Programming, Modules in Python, Numpy Library	20H

3.	Analyzing Cyclist Air Resistance: Velocity, Drag Coefficient, and Performance, 2R Robotic Arm Kinematics Simulation: From Equations to Animation, Otto Cycle Simulation and Analysis: Efficiency and PV Diagram	
4.	Simulating and Animating Damped Pendulum Motion, Pressure Computation and Relaxation Analysis using Newton-Raphson Technique, Exploring Parameter Meanings, Curve Fitting, and Analysis in Python, Engine Data Analysis and Visualization in Python	

5. References:

Text Book:

- Python Programming for Mechanical Engineers, Abdellatif M. Sadeq, 1sted. September 2023, ISBN: 979-8-9907836-4-5.
- Python Programming: An Introduction to Computer Science, John Zelle, Ingram Short Title

Reference Books:

- Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython – 2nd Edition, Wes McKinney,
- Programming Python: Powerful Object-Oriented Programming, 4th Edition, Mark Lutz
- Essential Python for Machine Learning, Abhishek Singh, ISBN-13: 979-8852254672, 2023.
- Python from the Very Beginning, John Whitington, ISBN-13: 978-0-9576711-5-7, 2nd ed, May 2023.

6. Course Outcomes (CO):

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ME-219.1	Understand basic Python programming concepts such as data types, control structures, and functions to solve mechanical engineering problems.	Understand	Understand
OEME 401.2	Apply Python programming techniques to perform numerical computations related to mechanical engineering, such as arrays, loops, and modules.	Apply	Apply
OEME 401.3	Analyze mechanical systems like a 2R robotic arm or Otto cycle using Python simulations and animations, and interpret the results.	Analyze	Analyze
OEME 401.4	Design Python programs to model and	Design	Create

	simulate real-world engineering problems like air resistance in cyclists and damped pendulum motion.		
OEME 401.5	Evaluate the performance of various mechanical systems by implementing Python-based curve fitting, data analysis, and visualization techniques.	Evaluate	Evaluate
OEME 401.6	Solve complex mechanical engineering equations using advanced numerical techniques in Python, such as the Newton-Raphson method for pressure relaxation analysis.	Apply	Apply

7. Mapping of course outcomes to module / course content

Module	CO1	CO2	CO3	CO4	CO5	CO6
1	1	3	2	2	3	-
2	2	-	2	3	-	1

8. Mapping of the Course outcomes to Program Outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1
CO1	3	-	-	2	1	1	-	1	1	-	1
CO2	3	-	-	2	1	1	-	1	1	-	1
CO3	3	-	-	2	1	1	-	1	1	-	1
CO4	3	-	-	2	1	1	-	1	1	-	1
CO5	3	-	-	2	1	1	-	1	1	-	1
CO6	3	-	-	2	1	1	-	1	1	-	1

9. Mapping to Program Specific Outcome (PSO)

	PSO1	PSO2
CO1	1	2
CO2	1	2
CO3	1	2
CO4	1	2
CO5	2	2
CO6	2	2

***** End of Syllabus*****

Course Name: PROJECT -I

Course Code: ME- 220

(Semester IV) Category: Minor

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1. Course Prerequisite:

Skills up to the previous semester level in Mechanical Engineering

2. Course Learning Objectives:

It is a research-based project that requires students to apply the knowledge and skills they have acquired during their course work to a real-world problem or research question. The project and thesis are designed to help students develop their research skills, critical thinking, and problem- solving abilities.

- To apply the knowledge and skills acquired during the coursework to a real-world problem or research question
- To develop research skills, including literature review, research design, data collection, data analysis, and interpretation
- To develop critical thinking and problem-solving abilities
- To produce a high-quality thesis that demonstrates the student's ability to conduct independent research
- To develop communication skills, including written and oral presentation

3. Teaching methodology and evaluation system for the course:

- Regular Meetings: Regular meetings between the student and supervisor to discuss progress, provide feedback, and set goals.
- Progress Reports: The student submits regular progress reports, outlining their progress, challenges, and plans for the next stage of the project.
- Peer Review: The student's work is reviewed by peers, providing feedback and suggestions for improvement.
- Workshop sand Seminars: The student participates in workshops and seminars, learning about research methods, academic writing, and presentation skills.
- Online Resources: The student has access to online resources, such as research articles, tutorials, and videos, to support their learning.
- Guest Lectures: Guest lectures from industry experts or researchers, providing insights into real-world applications and current research trends.
- Research Conferences: The student attends research conferences, presenting their research and learning from others in the field.
- Academic Writing Support: The student receives support and guidance on academic writing, including structure, style, and grammar.
- Time Management: The student receives guidance on time management, including setting goals, prioritizing tasks, and managing deadlines.
- Feedback and Evaluation: The student receives regular feedback and evaluation, including constructive criticism and suggestions for improvement.

Total Marks: 100

Passing criteria: 50% and above

- Literature review (10%)
- Research proposal (10%)
- Data collection and data analysis (15%)
- Results and discussion (15%)
- Conclusion and recommendations (10%)
- Thesis writing (20%)
- Thesis defense (20%)

4. Course Content: Course Name: Project-I

Course Code: ME-220

Hours per Week: 0L:0T:4P

Credits: 2

Description	Tentative Timeline (overlapped)
1. Literature Review - Conduct a comprehensive literature review on the research topic - Identify the research gap and formulate a research question - Develop a research proposal	4weeks
2. Research Design - Develop a research design, including data collection and data analysis methods - Identify the sampling strategy and sample size - Develop a data collection plan	4weeks
3. Data Collection - Collect data using the methods identified in the research design - Ensure that the data is accurate, reliable, and valid	8 weeks
4. Data Analysis - Analyze the data using the methods identified in the research design - Identify the trends, patterns, and relationships in the data	8 weeks
5. Results and Discussion - Present the results of the data analysis - Discuss the implications of the findings - Identify the limitations of the study	4 weeks
6. Conclusion and Recommendations - Summarize the main findings of the study - Provide recommendations for future research - Identify the contributions of the study to the field	2 weeks

7. Report Writing - Write a high-quality thesis that demonstrates the student's ability to conduct independent research - Ensure that the thesis is well-organized, well- written, and free of errors	12 weeks)
8. Presentation - Defend the thesis in front of a panel of examiners - Answer questions and provide clarification on the research	2 weeks

5. Course Outcomes

Course Outcomes	Details/Statement	Action Verb	Knowledge Level
ME-220.1	Apply knowledge of research methodology to Identify a research problem and develop a research proposal	Apply	Apply
ME-220.2	Conduct independent research and collect data	Conduct	Analyze
ME-220.3	Communicate research findings effectively through a thesis	Communicate	Understand
ME-220.4	Apply critical thinking and problem-solving skills To analyze complex data	Apply	Analyze
ME-220.5	Demonstrate expertise in a specialized area of research	Demonstrate	Evaluate
ME-220.6	Integrate knowledge and skills to produce a high-Quality thesis that contributes to the body of knowledge	Integrate	Create

6. Mapping of the Course outcomes to Program Outcomes

	PO1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1
CO1	1	1	1	1	1	-	1	3	2	-	1
CO2	1	1	1	2	1	1	1	3	1	1	2
CO3	2	1	1	2	-	1	1	3	1	1	1
CO4	2	1	1	1	1	-	1	3	1	-	2
CO5	1	1	2	1	-	1	1	3	1	-	2
CO6	1	1	1	1	-	-	1	3	1	-	2

7. Mapping to Program Specific Outcome(PSO)

	PSO1	PSO2
CO1	3	2
CO2	3	2
CO3	3	1
CO4	3	1
CO5	3	1
CO6	3	1

End of Syllabus